DECEMBER 1966

Communications

THE PROFESSIONAL JOURNAL OF RADIO COMMUNICATIONS

Inside this issue . . .

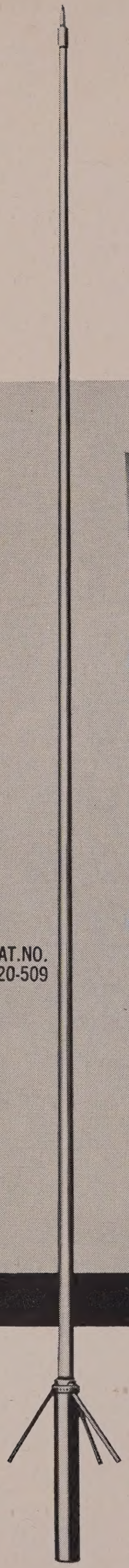
Base Station Intermodulation

Power Supply Standardization

Monolithic Crystal Filters

What's NEW in Communication Antenna Systems?

"CHECK THESE CPC DEVELOPMENTS AS STARTERS!"



NEW!

CAT. NO. 522-509 DUPLEXER

CAT. NO. 522-509 Duplexer for 450-570 Mc is an entirely new duplexer providing isolation in excess of 100 db between the transmitter and receiver at the transmit frequency and in excess of 40 db at the receive frequency. This isolation is maintained for transmit to receive separations of 2 to 20 Mc.

NEW!

CAT. NO. 220-509 SUPER STATIONMASTER

is a second generation antenna growing out of 30,000 STATIONMASTERS and ten years of experience with this type array. The new antenna has all the qualities of its predecessor, plus new features not now available in any antenna made for the land mobile services.

Because of its exceptional bandwidth, the SUPER STATIONMASTER is produced in three ranges which cover the VHF band, 150 to 159 Mc, 157 to 166 Mc, 165 to 174 Mc. A 10 db—10 Mc wide version, CAT. No. 455-509, is available to cover 450 to 470 Mc in two ranges.

NEW!

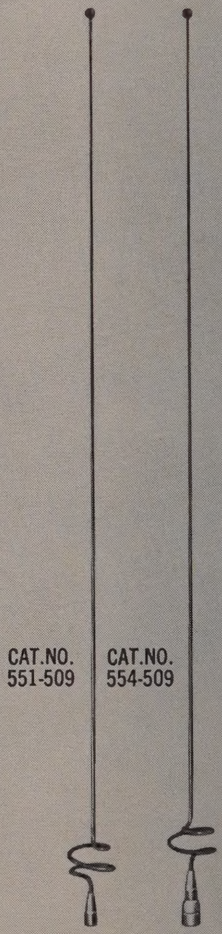
WIDER ADAPTABILITY FOR THE POPULAR CAT. NO. 251-509 2.5 db VEHICULAR GAIN ANTENNA

CAT. NO. 551-509 consists of the radiating element of Cat. No. 251-509 equipped with a mounting stud to fit the standard GE, RCA, or IPC Roof Top Mounts.

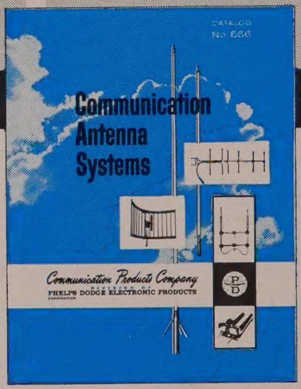
CAT. NO. 554-509 consists of the radiating elements of Cat. No. 251-509 and an adaptor to fit the standard Motorola Roof Top Mount.

NEW!

Additional CPC antennas and accessories are being featured in the CPC Handbook now going to press. Watch for them!



Then, check this new 64-page Antenna Handbook for up-to-the-minute specifications and data covering the complete CPC line of base station antennas, vehicular antennas, railroad and aircraft antennas, accessories, cable systems etc. For installers and specifiers of two-way mobile radio equipment, there is a special laboratory and field-tested data section. Reserve your copy now!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Communication Products Company
PHELPS DODGE ELECTRONIC PRODUCTS

Address inquiries to:

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NEW JERSEY 07746
Tel. (201) 462-1880

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CORPORATION

Circle 60 on Reader Service Card

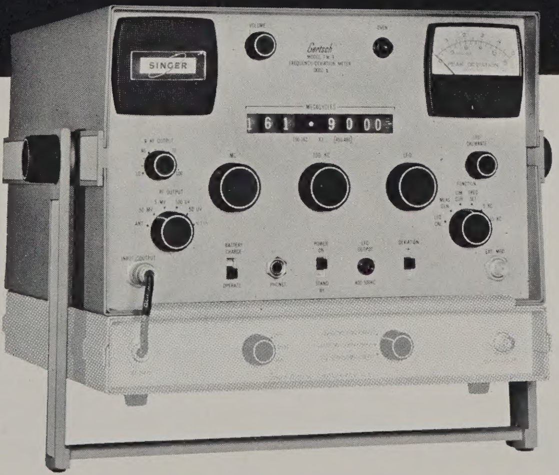
Now there is a single, portable instrument that meets the requirements of the communications engineer...

FREQUENCY METER

+ DEVIATION METER

+ SIGNAL GENERATOR

=



Add new bands with SNAP-ON
FC-3 or FC-4 Frequency Converter...

Gertsch*

*A Trademark of THE SINGER COMPANY

Snap-on FC-3 or FC-4 in 3 easy steps...

1

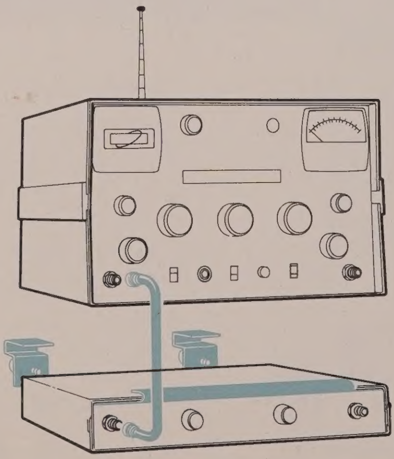
Slip lip of FC over front of FM-9.

2

Slip clamps over back of FM-9 and tighten thumb screws.

3

Connect two cables, and you're ready to operate. No adjustments, calibration or tuning.



MODELS FC-3 AND FC-4

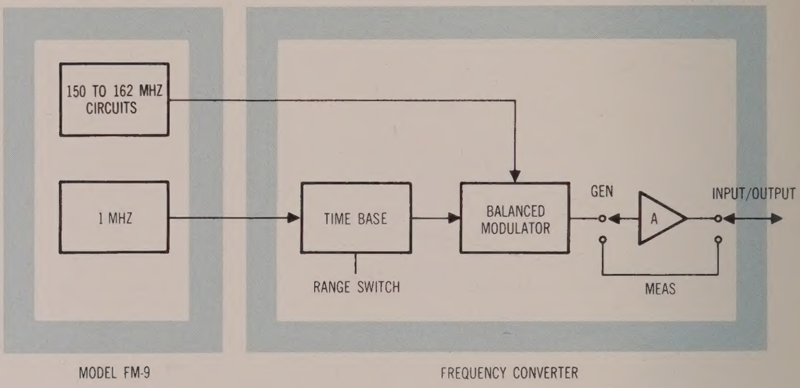
These Frequency Converters clip onto an FM-9 Frequency meter to add new bands. These bands are provided while maintaining most operating features of the FM-9, such as calibrated amplitude output, deviation measurements, frequency measurement, etc. The additional coverage is obtained by heterodyne action using a common time base.

IN OPERATION

the 1 mc time base of the FM-9 and power are fed to the FC (via rear cable supplied) where the 1 MHZ is multiplied up to a new time base, depending upon the position of the FC band switch. This signal is mixed with the output of the FM-9 (150-162 MHZ) to provide the additional frequencies. ■ Frequency is available as a calibrated output in the "Generator" mode of operation, or may be used to zero beat against the frequency being measured in the "Measure" mode of operation.

Two switches control operation of the converter: A mode switch selects the measure or generate mode of operation; a band-select switch sets the unit to one of the three bands. Once these units are set, operation is accomplished by the normal operating procedures of the Model FM-9.

No alignment or adjustment is needed. Power is supplied by the Model FM-9.



SPECIFICATIONS

	FC-3	FC-4
FREQUENCY RANGE (3 bands)	20 to 32 MHZ 30 to 42 MHZ 40 to 52 MHZ	140-152 MHZ 160-172 MHZ 170-182 MHZ
ACCURACY	±0.0005%	±0.0002%
SENSITIVITY (Frequency and Deviation Measurements)	2 MV (approx.)	2 MV (approx.)
RF OUTPUT: Range	50 MV to 0.5 uv	5 MV to 0.5 uv
Accuracy	±4 db (all except 20-32 mc)	±4 db
OPERATING TEMPERATURE RANGE	32° to 120°F (0 to 50°C)	32° to 120°F (0 to 50°C)
SIZE AND WEIGHT	2″ x 12¼″ x 14¼″ deep Wt: 7 lbs. (approx.)	2″ x 12¼″ x 14¼″ deep Wt: 7 lbs. (approx.)
POWER	Supplied by Model FM-9	Supplied by Model FM-9

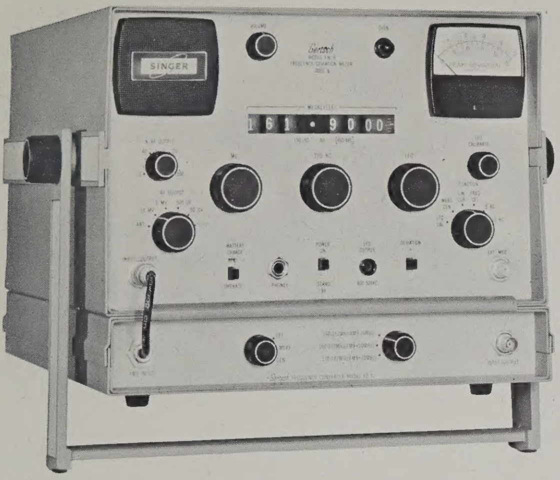
MODEL RFA-60 RF ATTENUATOR

The Model RFA-60 is a 60 db attenuator which allows keying of a transmitter when directly coupled to the Model FM-9 Frequency Meter.

MODEL BPS-1

Model BPS-1 is a 13.5-volt dc, alkaline, rechargable battery with a carrying case. The unit will provide a minimum of 8 hours of continuous operation.

Gertsch
INSTRUMENTS



SPECIFICATIONS

FREQUENCY RANGE
Fundamental: 150-162 MHZ (cont. variable)
Harmonics: 450-486 MHZ (cont. variable)
All channels clearly indicated — a calibration point at each channel on fundamental range.

ACCURACY 0°C-50°C
Frequency measurement: .0002% after 30 min. warmup
Deviation measurement: 2 ranges
5 KHZ & 15 KHZ ±5%

SENSITIVITY
Frequency measurement: 1 millivolt @ 150-162 MHZ
5 millivolts @ 450-486 MHZ.
Deviation measurement: 1 millivolt @ 150-162 MHZ
5 millivolts @ 450-486 MHZ.

ATTENUATION Output can be attenuated down to 0.5 microvolt for checking receiver sensitivity

R.F. OUTPUT Calibrated into 50 ohm load — ±4 db except .5 microvolt = ±2 db
50 millivolts to .5 microvolt @ 150-162 MHZ
10 millivolts to .5 microvolt @ 450-486 MHZ

ZERO BEAT INDICATOR
Built-in audio amplifier & speaker
Visual meter indication to less than 5 HZ.

EXTERNAL FM MODULATION 150-162 MHZ
±5 kc deviation over audio range of 300 HZ to 3000 HZ.
2 kc minimum at 100 HZ. 450-486 MHZ — 3 x the above range

POWER REQUIREMENTS
AC — 115/230 volts, 50/400HZ @ 7 VA
DC — 11.5 volts to 15 volts (aver. current approx. 0.3 ampere — neg. gnd.)

AUXILIARY OUTPUTS L.F.O. (400-500 KHZ) with high harmonic content 0.3 volt PP — 400 ohm source impedance. FM discriminator — for external scope output — source impedance 100 K ohms. 1 mc pulse (to calibrate with WWV signal)

SIZE Unit housed in a case 12″ wide x 8″ high x 14½″ deep

WEIGHT 23 lbs. (approx.)

MISCELLANEOUS
Built-in battery charger and voltmeter
6 ft. of 50 ohm coax. cable — BNC to UHF connectors 12-volt power cord with automotive cigarette lighter connector (neg. gnd.)

MODEL FM-9

has been specifically designed to meet the requirements of the Land Mobile Communications Services. Unit combines the functions of a frequency meter, deviation meter, and signal generator in a single, compact, all solid-state instrument.

AS A FREQUENCY METER

the instrument both measures and generates any channel in the range of 150-162 MHZ. Unit utilizes the third harmonic of this reading to measure and generate all channels in the 450-486 MHZ range as well, and includes a 400-500 KHZ output for I.F. alignment. User merely sets the desired frequency on an easy-to-read digital display.

AS A SIGNAL GENERATOR

the Model FM-9 is equipped with both coarse and fine precision attenuators, enabling use of the instrument for checking receiver sensitivity.

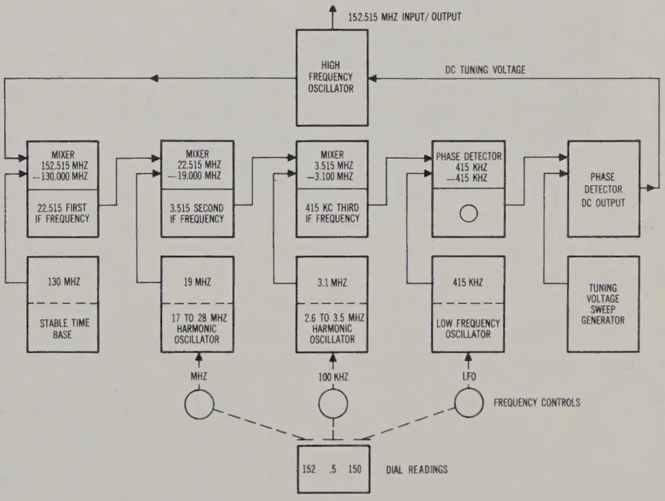
AS A DEVIATION METER

the instrument has a dual range, measuring peak modulation deviations of 0-5 KHZ or 0-15 KHZ with an accuracy of ±5% of full scale. A switch is provided to check both upper and lower sidebands, and a 'scope output jack is available for visual observations.

A rear panel switch enables the FM-9 to be phase locked to the 1 MHZ time base at 5 KHZ intervals. This feature provides crystal stability (±1 ppm) every 5 KHZ from 150 to 162 MHZ.

The FM-9 may be easily manufactured to accommodate any one of five 12 MHZ bands. When requesting an FM-9 with one of these special frequencies, please use the following identification:

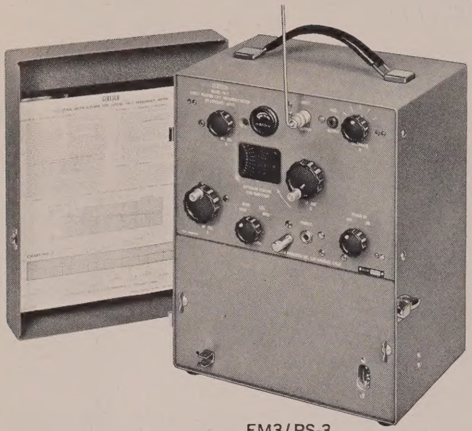
FREQUENCY RANGE	NOMENCLATURE
130-142	FM-9A
140-152	FM-9B
150-162 Standard	FM-9
160-172	FM-9C
170-182	FM-9D


152.515 MHZ INPUT/ OUTPUT
HIGH FREQUENCY OSCILLATOR
DC TUNING VOLTAGE
MIXER 152.515 MHZ —130.000 MHZ
22.515 FIRST IF FREQUENCY
MIXER 22.515 MHZ —19.000 MHZ
3.515 SECOND IF FREQUENCY
MIXER 3.515 MHZ —3.100 MHZ
415 KC THIRD IF FREQUENCY
PHASE DETECTOR 415 KHZ —415 KHZ
PHASE DETECTOR DC OUTPUT
130 MHZ
STABLE TIME BASE
19 MHZ
17 TO 28 MHZ HARMONIC OSCILLATOR
3.1 MHZ
2.6 TO 3.5 MHZ HARMONIC OSCILLATOR
415 KHZ
LOW FREQUENCY OSCILLATOR
TUNING VOLTAGE SWEEP GENERATOR
MHZ
100 KHZ
LFO
FREQUENCY CONTROLS
152 .5 150
DIAL READINGS

The high frequency oscillator is controlled by various frequencies. derived from a 1 MHZ crystal oscillator and an interpolating frequency from a low frequency oscillator. In this type of frequency synthesizer, phase-lock loops are used as the control elements and frequency multiplier and divider circuits are used to derive frequencies from the crystal. The above figure shows a typical controlled frequency and the correlation of dial settings, control frequencies, and final output frequency.

Frequency Measuring Equipment

Gertsch
INSTRUMENTS



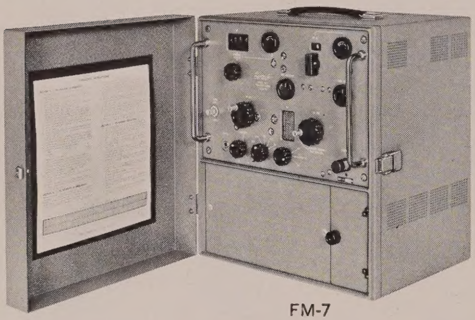
FM3/PS-3

VHF FREQUENCY METER

Direct reading VHF frequency meter, known as the standard of the industry. Extremely accurate and stable (.001%), designed for measurement and generation of frequencies. Basic frequency range is 20 to 40 MHZ. Using harmonics, the FM-3 will measure and generate frequencies from 20 to 1,000 MHZ, with continuous coverage over the entire range. Also harmonics of frequencies down to 1 MHZ can be measured. Unit may be used to set peak deviation on FM transmitters when used with the Model DM-3.

MODEL FM-3 (battery operated, does not include batteries)
MODEL FM-3/PS-3 (AC operated, internal power supply)
MODEL FM-3/PS-3C (AC & battery operated, uses AC Supply)
MODEL FM-3R (AC operated, rack mounted)

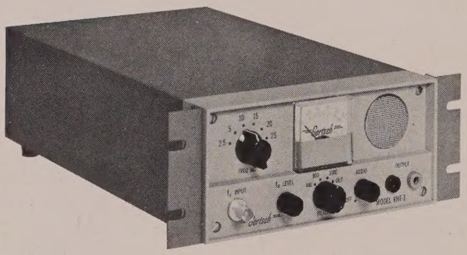
NOTE: All AC Models include power supply.



FM-7

VHF FREQUENCY METER / Portable

Internal oven-controlled 1 MHZ crystal oscillator (stability .00001%) provides minimum measuring accuracy of .0002% (direct reading) or .0001% (with correction curve) over frequency range of 20-1,000 mcs. *Exceeds* FCC frequency requirements. FM-7 may be used as a signal generator over range of 20-1,000 MHZ with both internal AM and FM modulation. This portable instrument, when combined with DM-3 Deviation Meter and RFA-1 Attenuator, provides a complete package for the communications Service Engineer.



RHF-1

HIGH FREQUENCY STANDARDS RECEIVER

Model RHF-1 is an all-transistorized superhetrodyne receiver designed for the reception of WWV and other high-frequency standard transmissions. Instrument provides a low-cost means of rapidly checking the calibration of oscillators and frequency standards to an accuracy of up to one part in 10^7. Other applications include: precision time measurements, receiving standard audio frequencies, pulse code modulation, and radio propagation notices which are transmitted at these frequencies.

FM-9	$1595.00	BPS-1	30.00	BASIC FM-3	850.00
FC-3	$ 300.00	RFA-60	19.50	BASIC FM-7	2025.00
FC-4	$ 300.00	DM-3	360.00	BASIC RHF-1	575.00

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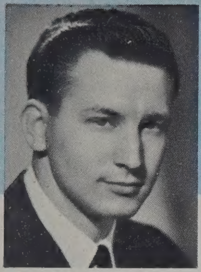


EDITORIAL

By Stanley M. Searle

A Good Year for Mobile Radio

1966 was a great year for mobile radio. Sales zoomed to around $200,000,000, twice as high as some more conservative, highly publicized estimates. Sales could have been even higher if it were not for the channel congestion problem.

During 1966, COMCO introduced a $1,000 mobile unit, fully solid state except for one tube in high power models. Aerotron released a hybrid 100-watt mobile unit priced at $695. Kaar (Canadian Marconi) introduced similar equipment. RCA introduced its 100% solid state Super Fleetfone line and GE pushed, with a great deal of success, its Master line. ARC introduced a scrambler and a base station concentrator. Motorola continued to get the biggest share of the market, and imports of Japanese CRS equipment reached an all-time high.

VHF-FM marine radio finally got started during 1966. Fisher introduced a VHF-FM marine set as did Konigsberg and Pearce-Simpson. Kaar sold a lot of its VHF Clippers and Hartman sold out its entire production run.

CB station license applications soared to an estimated 255,000 for the year. New solid state CB transceivers appeared on the market. Multi-Elmac introduced a $69.50 rig and Hallicrafters announced a solid state mobile unit priced at under $100. Eico and others will introduce new models early in the new year.

Polytronics moved from New Jersey to Maryland. Stuart Meyer left Hammarlund to join Aerotron, and Dr. Byron St. Clair took over at Hammarlund. Geoffrey Tellet left Kaar to form his own company, and Kent Worthem left GE to become president of Texas Crystals. Fairchild sold its Du Mont mobile radio business to Gonset, and a division of GE went into the CRS walkie-talkie business.

RCA got a $4,200,000 contract from the New York City Transit Authority for 4700 mobile units and 21 base stations. The Pennsylvania Railroad ordered 2700 mobile units and base stations, dividing the business between Motorola and WABCO.

What's ahead in 1967? Under the positive leadership of Chairman Rosel Hyde, the FCC will probably require type acceptance of CB transceivers. National and other companies will probably enter the VHF-FM marine radio field, and Lafayette will undoubtedly continue to introduce a new walkie-talkie or CB transceiver almost every week. Allied will continue to introduce new test equipment kits, as will Heath.

Cardion (formerly Budelman) will introduce a new line of solid state microwave equipment. The Burlington Lines will install a Collins microwave system. The Northern Pacific will expand its microwave facilities and more railroads will order microwave equipment as a result of a court order affirming FCC action requiring the Bell System to modify its Telpak rates.

More mobile radio equipment will be sold through independent dealers than in any previous year. Many dealers will expand their activities to include CCTV and tone signaling systems. If basic materials don't become scarcer, 1967 should be a banner year for the communications industry. □

Robert E. Brooking:

NAB Regional Conferences

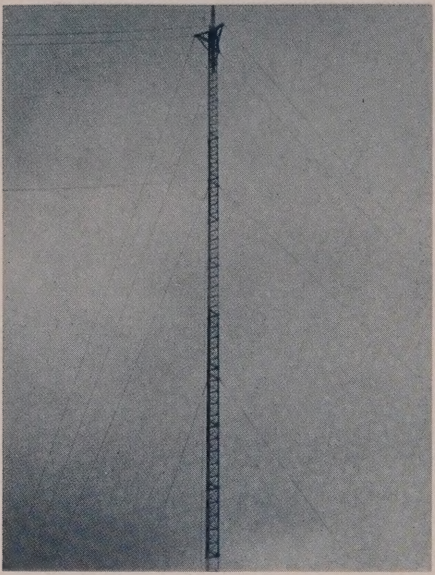
During the past few days several things have happened which will directly affect the Land Mobile Radio Services. The National Association of Broadcasters held a series of Regional Conferences. One of the agenda items at these Conferences was a panel entitled "Land Mobile and the Spectrum." This was the result of an invitation by NAB to the Communications Committee of the National Association of Manufacturers. The invitation was made because certain people in the NAB leadership do feel that Land Mobile Radio does have a spectrum problem and it would be well for the TV Broadcasters to know more about the situation.

Among those speaking for the NAM Communications Committee were Robert Wertz, Vice-President U.S. Steel Communications Company and Chairman of the Committee, and Herrick W. (Tex) Davis of Lockheed Corporation. It was my pleasure to participate in the meetings in San Francisco and Denver as the representative of Public Safety. Joe Koski attended the session in Dallas, Texas. William Carlisle, NAB Vice-President for Station Services, presided. Douglas Anello, NAB General Counsel presented the NAB position.

At the San Francisco session, Commissioner Kenneth A. Cox participated and did a most excellent job of explaining the role of the Advisory Committee for the Land Mobile Services. Some Broadcasters had been led to believe that the Advisory Committee was working on the question of reallocation of spectrum space. The Commissioner stated that the Committee had been specifically enjoined from such considerations but was, instead, engaged in means of improving usage of that portion of the spectrum presently allocated to the Land Mobile Services.

The Commissioner added that the results of the work of this Committee were beginning to show that only very limited relief could be obtained in this way and the ultimate solution would require reallocation, sharing or both and in this light, NAB would be interested in the final report.

The sessions were most friendly and I left them feeling that the members of NAB have a better understanding of the problems of Land Mobile Radio. □



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1. Make sure the manufacturer has wide experience in designing and building high quality communications towers. (A specialty of Fort Worth Tower Company.)

2. Buy the product that will best fulfill all your communications needs. (A reliable, job-engineered Fort Worth Tower.)

3. Accept nothing less than complete, fully professional installation service. (The only standard at Fort Worth Tower Co.)

Follow these steps and you'll get unexcelled tower performance in your mobile or point-to-point radio communications. Fort Worth Towers are designed to give you the **best** service possible . . . and they do it economically. Contact Fort Worth today and put this unbeatable formula to work for you!

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Circle 61 on Reader Service Card.

DECEMBER, 1966

Volume 3 — Number 12

Communications

Published by Communications Publishing Corp.
P.O. Box 63992, Oklahoma City, Oklahoma 73106

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STAFF

Stanley M. Searle • *Editor*
John Paul Johnson • *Managing Editor*
Robert A. Searle • *Associate Editor*
Leo G. Sands • *Associate Editor*
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Frances Poe • *Circulation*
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PUBLISHERS: Patrick T. Pogue and Stanley M. Searle.
GENERAL OFFICES: 1839 N.W. 16th, (P.O. Box 63992), Oklahoma City, Oklahoma 73106, (405) JAckson 8-3523

SCANNING
MEN IN THE NEWS

William F. Keally has been appointed manager of marketing for precision instrument products of the communications division of Motorola, Inc., by **Kenneth E. H. Backman,** manager of precision instrument products. In this position, Keally has responsibility for all marketing and product planning activity; order processing and administration; bids and quotes; planning and scheduling and marketing research.

Gilbert C. Larson, formerly director of engineering of Aerotron Corp. and the communications division of ITT, has been named to the post of director of engineering, commercial products division, at Hallicrafters. Larson will be responsible for the development of the firm's expanding lines of both technical and consumer communications products including citizens two-way and industrial two-way radio; short wave receivers; and amateur radio equipment.

Curtis R. Hammond is Hallicrafter's new vice president and director of commercial marketing. Hammond is a veteran of more than 25 years of marketing, engineering and management in the electronics industry. Most recently he was vice president and director of engineering for Hoffman Products Co., Chicago producer of private-brand television and stereo products.

Lawrence J. Torn, vice president—sales of Trygon Electronics Inc., Roosevelt, N. Y., manufacturers of DC power supplies has announced the appointment of **John Topel** to the post of western regional sales manager. Topel will assume management of Trygon's western sales offices located at 6208 W. Manchester Ave., Los Angeles, California.

Roger E. Bucklin has been promoted from production supervisor to production manager at Polytronics Laboratories, Inc., a subsidiary of Vitro Corporation of America. He was with the Vitro Electronics division for 12 years before moving over to Polytronics.

Dave Michalak and **Ed Kukula** have been assigned to newly-created key managerial posts in the communications division of Motorola, Inc. Dave Michalak, formerly senior portable product planning analyst, is promoted to the position of manager of product planning—two-way portable products. Michalak has seven years experience in mobile and portable product planning and marketing research in the communications division. Ed Kukula is promoted to the position of manager of product planning—paging products. Kukula recently joined Motorola as a consultant in the national market development group. Prior to that he held product and sales management positions with two major electronics firms.

Henry T. Hardenburg has been named European sales manager for Communication Electronics, Inc. The appointment of Hardenburg to direct European sales efforts is one of the steps in the company's program to strengthen and expand worldwide marketing of CEI products, according to president **Ralph E. Grimm.** A veteran of 20 years naval service, Hardenburg retired in 1965 with the rank of Commander. While attached to the Office of Naval Intelligence, he was for six years stationed in Central Europe.

Charles E. Krampf, executive vice-president of Aerovox Corp. has announced the appointment of **Alvin L. Schils** as works manager of the company's Olean, New York plant. In this newly-created position, Mr. Schils will be responsible for all production, industrial engineering, material control, production control, purchasing and personnel functions at the Olean facility.

Allan Lytel, one of the best known authors of books and magazine articles on communications, died in July. He had held key posts with Avco Corporation and General Electric.

Paul Boberg has left Hammarlund where he was in charge of quality control and earlier head of development of SSB equipment.

Walter Salm, associate editor of *International Electronics,* has moved over to a new post within the Johnston publishing firm.

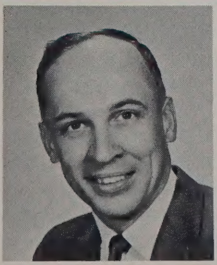
Dr. Jose Luis Herrera has been appointed senior engineer at Alfred Electronics, president **Albert Jew** announced. The firm manufactures electronic instruments. Most recently, Dr. Herrera served as a research engineer for Santa Rita Technology, Menlo Park, California. He also has served as a consultant to Fairchild Semiconductor Corp., Mountain View, Calif., and as a design engineer for Lenkurt Electric Company of Canada.

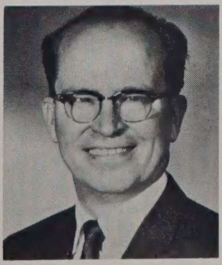
Edgar L. Van Cott, Jr., has been named military PCM programs manager for Raytheon Company's communications and data processing operation, Norwood, Mass. Raytheon is producing PCM (Pulse Code Modulation) military communications equipment at its Norwood and North Dighton, Mass. plants. With PCM equipment, voice signals are converted to digital form for transmission. They are subsequently reconstructed upon receipt. Van Cott was program manager for a countermeasures rocket program in Raytheon's Missile Systems Division, Bedford, Mass. from 1962 until 1966. From 1961 to 1962, he was a project engineer on the same program. Earlier, he was a project engineer on various missile programs including the Hawk.

Irving Strauber is the new amateur products sales manager for Hammarlund. He will be responsible for all amateur product and SWL receiver sales, and for the creation of a new generation of Hammarlund equipment. Before joining the Hammarlund organization, he was sales manager of Strager Electronics Corp., and public relations and sales promotion consultant for a number of companies.

John R. O'Neill has been named sales engineer for the communications systems division of Jerrold Electronics. According to an announcement by division manager **Vroman W. Riley,** O'Neill will head up the recently established midwestern sales office, located in Palatine, Illinois. The office serves a 13-state area with Jerrold's microwave, data multiplex and related equipment.

John S. White, Sr., has been appointed power transistor sales manager for TRW Semi-conductors according to **Dan Rasdal,** transistor plant manager to whom he will report. Prior to joining the TRW, Inc. subsidiary, White had been western regional sales manager for Phelps Dodge Electronic Products Corp.


William F. Keally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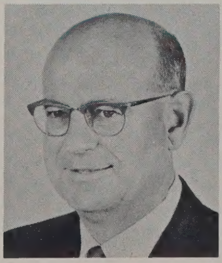

Curtis R. Hammond

Ed Kukula

Roger E. Bucklin

Dave Michalak

SIGNALS

FCC AMENDS PART 21

Part 21, FCC Rules and Regulations, covering RCC and mobile telephone services, has been amended to permit licensees to replace transmitters without having to file a formal application. Section 21.121 has been amended to read as follows:

(a) The licensee of a station in this service may replace a transmitter without specific authorization by notifying the Commission at Washington, D.C. 20554, and its Engineer in Charge of the radio district wherein operation is to be conducted, at the time of the installation of the transmitter, if the replacement transmitter complies with the following conditions:

(1) Appears on Commission's current type-acceptance list for use under this Part 21 (see § 21.120) and is installed without modification.

(2) Its type-accepted output power is equal to the authorized output power for the transmitter being replaced.

(3) Conforms to the frequency, class of station and emission specified in the current instrument of authorization and all other applicable rules and regulations.

(b) For all transmitter replacements made pursuant to paragraph (a) of this section, any changes in input power, make and type of transmitting equipment must also be indicated on the next application for renewal of license or in the next application for modification of license, whichever is filed first. Requests for authority to make other changes in equipment shall be submitted to the Commission in appropriate applications and replacements which require applications may not be made until an authorization has been issued by the Commission. Notification is not required for a replacement which conforms in all respects to the authorized transmitter.

(c) The notification required by paragraph (a) of this section shall include:

(1) Radio service and station call sign.

(2) Location of replacement transmitter as shown on current license.

(3) Name of the manufacturer and type number of transmitter installed, as it appears on the current type-acceptance list.

(4) Rated output power of such transmitter.

(5) Identification of the transmitter being replaced (and where applicable, point(s) of communication) and the frequency on which such transmitter operates.

FCC AMENDS RULES

The FCC now recognizes Hertz as the equivalent of one cycle per second. So get used to kilohertz (KHz) for kilocycles and megahertz (MHz) for megacycles.

Part 91, covering the Industrial Radio Services, has been amended to permit a licensee to install mobile units, licensed to him, in vehicles of persons under contract to the licensee to furnish services or facilities directly related to the activities that constituted the licensee's eligibility for the applicable station license. Control must remain with the licensee and there must be a written agreement verifying that the licensee has the sole right to control the mobile radio units. Full details are spelled out in paragraph 91.6 of the rules as amended on November 2, 1966.

NEW YORK SUBWAY RADIO SYSTEM TO BE EXPANDED

Bids have been requested for furnishing and installing two-way radio equipment for the entire IRT division of the New York Subway System by the New York City Transit Authority. Bids are due December 16.

Motorola equipment is now in use on the Lexington Avenue line between 125th Street and Bowling Green. The new procurement will provide for expansion of the radio system throughout the boroughs of Manhattan, Brooklyn, Queens and Bronx.

It is expected that WABCO, Motorola, GE and RCA will be among the bidders.

FCC STUDIES SHARING OF TELEVISION CHANNELS

A meeting was held by industry and FCC personnel concerned with sharing of television channels with the land mobile services. As a result, the Commission adopted a Further Notice of Inquiry in Docket 15398 in which it concluded that the information necessary for a decision regarding shared use of television channels by stations in the land mobile services is incomplete and that some of the required data can be obtained only through field tests involving actual operation of a typical land mobile system on a television channel. Additionally, the Commission requested information from interested parties concerning television receiver characteristics.

As an initial step toward setting up field tests, the Commission is establishing an advisory committee to be composed of representatives from the Commission, The National Association of Broadcasters (NAB), Electronic Industries Association (EIA), National Association of Manufacturers (NAM), Association of Maximum Service Telecasters, Inc. (AMST), and the Joint Technical Advisory Committee (JTAC). This committee will be expected to: (1) assess and analyze the information now available which bears on the feasibility of sharing television channels; (2) identify such additional information as may be necessary or desirable for a proper decision in the matter; (3) determine what part of, and the manner in which, such additional information can be obtained through field tests; (4) set up parameters and guidelines for tests which will provide meaningful results under conditions closely approximating normal operations of land mobile stations; (5) arrange for and conduct such tests; and (6) submit appropriate reports to the Commission concerning such test data.

As pointed out in the initial Notice of Inquiry in this proceeding, consideration of the feasibility of sharing television channels by stations in the land mobile radio services is restricted initially to the VHF Channels 2 through 13 since the VHF table of assignments is more stabilized than is the table of UHF assignments which is being changed frequently. Testing of UHF channel sharing may, however, be conducted at a later date. So long as the test purposes and parameters are reasonable, no other restrictions will be placed on the committee at this time except that such tests should be conducted in a thoroughly professional manner and as expeditiously as possible.

IEEE VEHICULAR COMMUNICATIONS GROUP CONSIDERING NAME CHANGE

Members of the IEEE Vehicular Communications Group are being asked to register approval or disapproval of a change in the group's name. The ballot reads as follows:

"The field of interest of the Group shall concern itself with vehicular communications and electrical and electronic engineering. Vehicular communications shall include all land, airborne and maritime mobile services as well as personal paging and citizens communications services when used as an adjunct to a vehicular system. Vehicular electrical and electronic engineering shall include all engineering technologies which support the vehicle's functional purpose."

Members are urged to submit their comments and informal ballots to Jack Neubauer in care of RCA, Building 17C-6-9, Camden, New Jersey 08102.The group has some 1700 members.

NY BUS RADIO SYSTEM DESCRIBED AT IEEE MEETING

Harry Boyle and H. G. Johansen of RCA presented a paper about the New York City Bus Radio System (world largest) at the October 26 luncheon meeting of New York Chapter of the IEEE Group on Vehicle Communications. Boyle is regional manager for RCA, based at East Orange, New Jersey. Previously, he was national field sales manager for RCA mobile radio and, for a time president of Shirdan Corp. He has also worked for Motorola and DuMont.

SOUTHERN CALIF. EDISON EXPANDS COMMUNICATIONS NET

Southern California Edison Company has ordered eight RCA CW-60 microwave stations for a backbone system to link existing light-route microwave paths, the RCA Broadcast and Communications Products Division has announced.

J. A. Lang, Manager, Microwave Sales, said the new system also would serve as a connection with Pacific Gas and Electric Company for joint operation of the extra high-voltage transmission line carrying power from the Pacific northwest to southern California. Covering some 160 microwave path miles, the system will link Southern California Edison's communication network with PG&E's at Midway near Bakersfield.

E. F. JOHNSON REVEALS RECORD EARNINGS AND SALES

E. F. Johnson Company, two-way radio and electronic component manufacturer, has announced record sales and earnings figures for the nine months ended September 30. Sales were $10,851,998, an increase of 18.7 per cent, compared with $9,139,349 for the same period last year, and after tax net earnings rose to $1,380,902, an increase of 26.3 per cent, compared with $1,093,163 for the like period in 1965. Earnings per share were $1.66 for the nine-month period, almost as much as the $1.77 for all of 1965. The company also announced a quarterly dividend of 17.5 cents per share.

HIGHWAY CALL BOXES

Until every car and truck is equipped with a mobile telephone, the motoring public will have to depend on hand signals, open hoods and long walks to telephones to summon aid when needed, except on roads equipped with "call boxes." Hoffman Electronics Corporation is among the manufacturers now producing highway call boxes.

The Hoffman system consists of a series of call boxes and a base station operating on 72.5 MHz.

Each call box is capable of transmitting up to 15 different messages in the form of coded FSK tone signals. At present, call boxes are equipped with two to four push buttons to enable transmission of two to four messages from the roadside.

The base station can receive messages from up to 10,000 call boxes. The message and location of the call box can be seen on a visual display. Hard copy printout can also be provided.

The call box transmitters are powered by batteries kept charged by an array of solar cells.

The State of Maryland is installing a Hoffman call box system on a 43-mile stretch of the Capital Beltway around Washington, D.C. Some 328 boxes will be installed at intervals of four, eight

GET MORE* ACTION WITH

MULTI-ELMAC

PRECISION MADE, PROFIT PACKED CB UNITS!

***CITI-FONE SS**

FULL 23 CHANNEL

AC-DC Operation • Illuminated Meter & Channel Selector • Triple Tuned RF • "Noise Immune" Squelch • Double Tuned IF's • Complete, Ready to Operate

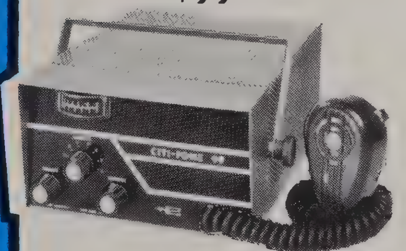
$\$169^{50}$

***CITI-FONE 99**

FULL 8 CHANNEL

AC-DC Operation • Delayed AVC • Electronic Switching • 2 Stage Pre-Amp • Illuminated "S" Meter • Complete with Crystal for 1 Channel

$\$99^{50}$

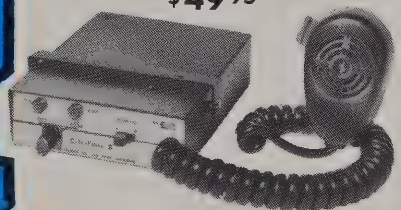


***CITI-FONE II**

SOLID STATE Transmitter-Converter

Compact 5¾ x 4⅜ x 1½ • 9 Transistor • 2 Diodes • 5 Watt Input (FCC Max.) • 100% Modulation, • 12 VDC Operation, Complete with Crystal for 1 Channel

$\$49^{95}$



Please send further information on Citi-Fone SS ☐, 99 ☐, II ☐

MULTI-ELMAC COMPANY
21470 Coolidge • Oak Park, Michigan 48237

NAME__________

ADDRESS__________

CITY__________ STATE__________ ZIP__________

Circle 62 on Reader Service Card

and 12 per miles, 100 of which will have four buttons each allowing motorists to call for police, repair, fire or ambulance assistance.

Where terrain conditions prevent getting through on 72.5 MHz, a repeater is used which receives on 72.5 MHz and transmits to the base station in the 450-570 MHz band.

EIA TO STAGE ELECTRONICS SHOW

The Electronics Industries Association has designated the fourth week of June, 1967 as "Consumer Electronics Week." An exhibit of consumer electronic equipment will be presented that week at the New York Hilton Hotel in New York City according to Jack Wayman, EIA vice president. Wayman before joining the EIA, was an Outercom mobile radio sales engineer.

RADIO NETWORK EXPANDS

Tropical Radio Telegraph Company, the communications subsidiary of United Fruit Company, has awarded a $300,000 contract to Gates Radio Company for 10 new single sideband transmitters to beef up its communications network between the United States and Central America.

Tropical, operating the world's fourth largest international public communications network, has provided service linking the United States and Central America since 1904, first serving United Fruit exclusively and later opening its vast facilities for public communications.

Extensive cable, as well as radio communications, provide telegraph, radio telegraph, telephone, radio telephone and telex services, all of which will be substantially enlarged under the announced expansion program. The new Gates equipment consists of three SSB 10kw, six SSB 3kw transmitters and one 1kw transmitter. First units will ship to United Fruit in January of 1967, with completion of transmitter installations in two stateside and three Central American locations scheduled for mid-1967.

SHOW CORPORATION ANNOUNCES SPRING CONFERENCE

Electronic Industry Show Corp. will conduct a Distributor-Manufacturer-Representative conference at the Hotel Traymore, in Atlantic City, New Jersey, from April 14th through April 17th, 1967.

This is the first conference of its type ever sponsored by Electronic Industry Show Corporation, according to Walter A. Clements, Littelfuse, chairman of the D-M-R Committee. It is open to all electronic parts distributors from Unit Territories 7, 8 and 10, covering eastern and southern Pennsylvania; western and southern New Jersey; Delaware, District of Columbia, Virginia, and Maryland.

The conference will open at 7 p.m. on Friday, April 14th, and will feature conferences on Saturday, Sunday, and Monday, primarily during the morning hours.

Liaison for the conference will be handled by Harry Estersohn, representing the sales representative function, Joe Forti, Albert Kass, and Morris Green for NEDA, and Walter Goodman, Jerrold and Robert Ferree, IRC, for the manufacturing segment.

ALLIED RADIO DOUBLES PLANT CAPACITY

Construction is now under way that will add 190,000 square feet of office and warehouse space to Allied Radio's present block-square two-story building in the company's central Chicago location

YOUR BEST CHOICE FOR PROFITS . . .

Hammarlund all solid-state receiver, power supply and hybrid transistorized transmitter. Available in either under-dash or trunk mount.

HAMMARLUND

FM TWO WAY RADIOS

Get in on the profit side of FM Two Way Radio—the fastest growing market in the electronics industry—with the fastest-growing product line available! HAMMARLUND offers a full line of FM Two Way equipment for high band and low band use (24-54 MC; 144-174 MC) . . . featuring 16 different mobile units, 24 base station models, and two monitoring receivers.

Special features include transistorized power supply . . . complete interchangeability from vehicle to base and vehicle to vehicle . . . non polarity-conscious equipment . . . high frequency crystal lattice filtering . . . battery-saving standby position . . . maximum performance from commonly available power supplies.

HAMMARLUND leads the field in FM Two Way Radios. For sales-building quality and economy, stock these popular models. Boost your profit picture with HAMMARLUND!

Exclusive Territories Available for Qualified Distributors

HAMMARLUND
MANUFACTURING CO.
73-88 Hammarlund Dr. • Mars Hill, N.C.
(704) 689-5411

Gentlemen:
Please send complete information on HAMMARLUND FM Two Way Radios and exclusive distributorships available.

NAME ____________________

FIRM ____________________

ADDRESS ____________________

CITY __________ STATE ____ ZIP CODE ____

Circle 63 on Reader Service Card.

an open letter to dealers

Dear Dealer:

I am looking for progressive dealers alert to an opportunity to get in on the ground floor with a company and product line on the way UP!

When Vitro Corporation of America, a defense oriented company with over $60,000,000 in sales and a listing on the New York Stock Exchange, acquired control of Polytronics early this year, they told me to do whatever has to be done to get and keep a fair share of the CB and Business Band 2-Way Radio market. We intend to do just that!

Since that time, we have introduced a number of new, advanced pieces of CB equipment. We have reduced the prices on some of the items substantially. Not because they were overpriced to begin with, but so that we and our dealers could introduce them into the market more readily. We have increased our dealer's discounts across the board. We are advertising in Popular Electronics, CB, S9, and a number of trade magazines.

Quality and quality control have been emphasized. Before taking this job, I was in charge of quality control and manufacturing for Vitro Electronics, which manufactures electronic equipment for defense and space use . . . where extreme quality control and reliability are not only desirable but mandatory . . . and we are carrying the same standards over to our CB equipment. For example, we use only teflon coated wire . . . we use solder coated printed circuits. Sure it costs more, but what does this mean to you, the dealer? It means less failures in operation because the solder coating reinforces the copper printed circuit and covers hairline breaks . . . it means that if the set is ever brought back to you for repair, you can make easy solder to solder connections on the printed circuit, and you don't have to worry about burning the teflon insulation off the wires with your soldering iron.

If you are in the CB business to stay, as we are . . . if you believe that people will pay a little more for quality, then we would like to talk to you about the Polytronics CB line. There are no obligations. Send in the postpaid card below for more information about how you can get in on the ground floor with a company on the way UP!

Sincerely,

Jack Spink

Jack Spink
General Manager

POLYTRONICS
LABORATORIES, INC.
900 Burlington Ave. Silver Spring, Md.

POLYTRONICS LABORATORIES, INC.
(A Subsidiary of Vitro Corporation of America)
900 Burlington Avenue, Silver Spring, Maryland

Yes, Mr. Spink, I would like to know more about the POLYTRONICS line.
Please send me literature ....

Please have your representative telephone for an appointment ....

Name ....

Company ....

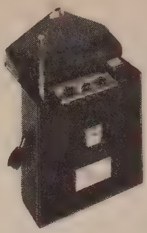
Address ....

City .... State .... Zip .... Tel. ....

C 126

CARRY-COMM 5 Watt Walkie-Talkie

A portable, heavy duty 5 watt walkie-talkie with 7 channel coverage. Also can be used as a mobile radio in auto or boat; and as a portable base station running on 12 DCV battery supply or 115 ACV current through its built-in battery charger. Carried in an "over-the-shoulder" leather case.
List price (minus transciever) $149.95



DUO-COMM 123, 3 Watt, 2 Channel Walkie-Talkie

Hand held, the increased power, range, multi-channel capability, with light weight, make the Duo-Comm 123 one of the most advanced hand held walkie-talkies on the market. Rugged, powered by rechargeable batteries, all solid state, with sealed Speaker/Mike transducer, impervious to weather or humidity. Dual conversion superheterodyne receiver circuit. List price $129.50

DUO-COMM 120 Walkie-Talkies

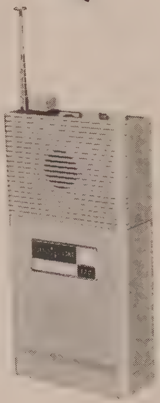
Rugged, 1 watt, 1 channel hand-held set made famous in 1963 Mt. Everest expedition. All solid state, rechargeable batteries, weather proof mike and speaker. Only dual conversion receiver in its price range on market. List price $109.50

Also available:

DUO-COMM 120 B—Works on AM Business Band frequencies.

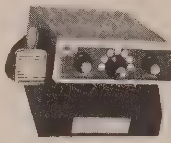
DUO-COMM 120 R—With remote controlled microphone.

DUO-COMM 120 HP—Special hazard proof set.



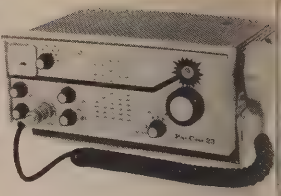
POLY-PUP 7 Channel CB Transceiver

Smallest radio of its quality on the market. All solid state: 14 temperature resistant all silicon transistors and 6 diodes. Solid die cast front panel and metal cabinet; rugged metal plug-in microphone easily replaced when required. List price $149.50



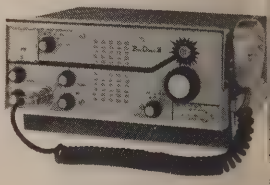
POLY-COMM 23—23 Channel CB Transceiver

The Cadillac of the industry with the most sensitive receiver on the market, extra rugged construction throughout. Teflon covered wiring, weather-proof speaker, hand-wired metal plug-in microphone, delta tuning, variable depth noise limiter, professional type metering system, public address capability, optional built in selective call. List price $299.50



POLY-COMM 30—31 Channel Transceiver

Offers all 23 CB Channels for long range mobile communications plus 8 additional part 15 channels to monitor short range walkie-talkie communications. Unlike many sets on the market, the Poly-Comm 30 is designed to prevent accidental or intentional switching from low to high power on the Part 15 channels. Dual conversion superheterodyne receiver with Nuvistor RF amplifier and mixer stages to insure 0.15 uv for 10 db/SN. Super-sensitive squelch, variable noise limiter, electronic switching. List price $329.50



POLY-COMM "B" & "H" FM Business Band 2 Way Radios

The greatest value in the FM Business Band field, these one channel, 18 watt FM Transceivers offer many more miles of range per dollar than their nearest competitors. Accessories, such as remote control unit, 50 and 100 watt boosters permit systems to be designed for any need.
List prices start at $299.95

POLY ACCESSORIES

A full range of accessories is available for all Polytronics equipment: including antennas, loud speakers, mounting brackets, power supplies, battery chargers, remote control heads, power boosters . . . all engineered to Polytronics' standards.

POLYTRONICS QUALITY TRANSCEIVERS

PLACE
STAMP
HERE

POLYTRONICS LABORATORIES, INC.
900 Burlington Avenue
Silver Spring, Maryland

> *"There is hardly*
> *anything in the*
> *world that some*
> *man cannot make*
> *a little worse*
> *and sell a little*
> *cheaper, and the*
> *people who consider*
> *price only are this*
> *man's lawful prey."*
> John Ruskin

at 100 N. Western Avenue. A third floor is being constructed over the present building, and a two-story connecting structure is being built to extend another block north from the present site.

The structure when completed will provide a total of 377,000 square feet for the company's operation and will accommodate more than 2,000 employees. In addition, Allied's manufacturing subsidiary, Knight Electronics Corp. will continue to occupy 110,000 square feet of space in the Chicago suburb of Maywood, Illinois. This plant expansion will permit Allied to dispose of office and warehouse space now leased in three other locations.

RADIO CLUB HOLDS ANNUAL BANQUET

The annual banquet of the Radio Club of America was held on November 29 in New York City. The club was founded in 1909. Its membership consists of many of the pioneers who founded the radio communications industry.

VWOA IN 42ND YEAR

On October 15, 1925, some 40 old-time wireless operators attended a meeting at the Roosevelt Hotel in New York City whose procedings were broadcast over radio station WRNY. It was the first official meeting of the Veteran Wireless Operators Association which now has some 500 members and whose honorary president is General David Sarnoff. Past honorary presidents include Herbert Hoover, Guglielmo Marconi and Lee De Forest. The VWOA has awarded Marconi gold medals to Anne Morrow Lindbergh, David Sarnoff, Lee De Forest, Franklin D. Roosevelt, James R. McNitt and David S. Little, among others.

Since 1944, the VWOA has been responsible for the care and maintenance of the Wireless Operators Monument in Battery Park in New York City which was erected in 1915 as a memorial to John George Phillips who lost his life on the ill-fated Titanic and nine other wireless operators who had perished in ship disasters.

Membership had been restricted to wireless operators, but the rules have been changed to permit others to join, under certain conditions. Those interested in joining this group whose membership includes many of the most noted names in electronics plus Barry Goldwater and Arthur Godfrey should write the VWOA at Box 35, New York, New York 10008.

COLLINS QUARTERLY REPORT

Collins Radio Company has reported earnings of $2.9 million, or $1.06 per share, on sales of $99.2 million for the three months ended October 28, 1966. Last year's first quarter earnings were $1,438,000 or $.64 per share, on sales of $81 million. The number of shares on which the per share earnings are based increased from 2,257,300 for the first quarter of fiscal 1965 to 2,724,000 in the most recent quarter.

The order backlog was $393 million at the end of October, up from $302 million a year earlier.

OUR COVER

B. J. Cole, installation supervisor for Collins Radio, checks out the RF communications system recently installed at Cape Kennedy. The phase-locked, closed-loop system utilizes single-sideband, suppressed-carrier and frequency-division multiplex techniques. The Operational Intercommunications System (OIS) employed by NASA consists of 112 channels at frequencies up to 500 KHz.

TG5-S Fixed Station Antenna

Tried and proven by engineers in the communications field, this three-stacked fixed station gives your customers the best possible performance with a gain of 10.5 db.

High gain is achieved by proper vertical spacing and phasing of radiating elements. Wasted high angle radiation is eliminated because the pattern is beamed at the horizon. Designed to mount on 1¼ inch pipe with the coax running through the support mast, the antenna may be cut to any frequency between 144 mc and 160 mc.

Gain over a coaxial type antenna is 10.5 db! 8.2 db over an isotropic, 6 db over a dipole.

Write GAM Electronics Inc., Manchester, New Hampshire, for more information about this and the rest of the antennas in the GAM power line Net price $79.25.

GAM ELECTRONICS, INC.

191 Varney St. • Manchester, N.H.

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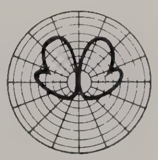
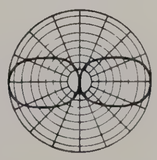




PLECTRON "PATROL" RECEIVERS

For Monitoring Any FM Communications Frequency

Best All Around Package On The Market

Also available as a combination monitoring and tone control receiver...to sound horn or turn on vehicle lights

Plectron **all transistor** alerting and monitoring receivers provide the best all-around package on the market. For use in home or car, AC or DC operation. Self-contained, rechargeable battery (optional) for portable operation and more than 24 hours receiving between charges. *Request Literature Sheet No. 413*

For immediate, dependable reception... ask for PLECTRON PATROL RECEIVERS.

Designed and Manufactured by

PLECTRON CORPORATION

Overton, Nebraska 68863

DISTRIBUTED IN CANADA BY WILSON & COUSINS, LTD.

Circle 65 on Reader Service Card

FCC to Probe Computers

James D. McLean (second from left) is among those who witnessed the turn-on of this Burroughs 220 computer. McLean was general sales manager for mobile radio at Philco back in 1949.

Even before the furor about the take-over of CATV regulation by the FCC has had the chance to simmer down, and before it has taken positive action to clean up the land mobile channel congestion, the Commission has announced its interest in still another area —computers and data transmission services. This action will be of interest to communications and computer users as well as to those who maintain computers and data transmission facilities. The scope of the investigation to be made by the FCC is as follows:

Describe the uses that are being made currently and the uses that are anticipated in the next decade of computers and communication channels and facilities for:

1. Message or circuit switching (including the storage and forwarding of data);
2. Data processing;
3. General or special information services;
4. Any combination of the foregoing.

Describe the basis for and structure of charges to the customers for the services listed above.

The circumstances, if any, under which any of the aforementioned services should be deemed subject to regulation pursuant to the provisions of Title II of the Communications Act.

1. When involving the use of communication facilities and services;
2. When furnished by established communication common carriers;
3. When furnished by entities other than established communication common carriers.

Assuming that any or all of such services are subject to regulation under the Communications Act, whether the policies and objectives of the Communications Act will be served better by such regulation or by such services evolving in a free, competitive market, and if the latter, whether changes in existing provisions or law or regulations are needed.

Assuming that any and all of such services are not subject to regulation under the Communications Act, whether public policy dictates that legislation be enacted bringing such services under regulation by an appropriate governmental authority, and the nature of such legislation.

Whether existing rate-making, accounting, and other regulatory procedures of the Commission are consistent with insuring fair and effective competition between communications common carriers and other entities (whether or not subject to regulation) in the sale of computer services involving the use of communications facilities; and, if not, what changes are required in those procedures.

An IBM 1401 computer equipped with the 1009 data transmission unit shown above can "talk" directly from its core memory to the core storage of any similar computer via telephone or telegraph lines. After communication, which takes place at rates up to 150 characters per second, the data is processed and recorded by the receiving 1401 in the form of punched cards, magnetic tape or printed records.

Whether the rate structure, regulations, and practices contained in the existing tariff schedules of communications common carriers are compatible with present and anticipated requirements of the computer industry and its customers. In this connection, specific reference may be made to those tariff provisions relating to:

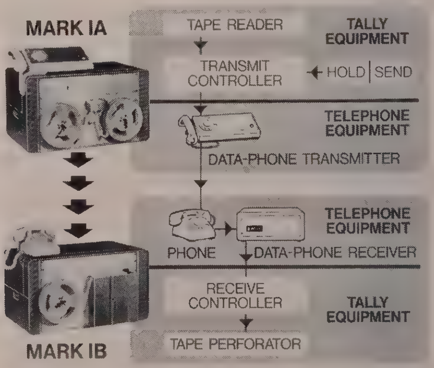
1. Interconnection of customer-provided facilities (owned or leased) with common carrier facilities, including prohibitions against use of foreign attachments;
2. Time and distance as a basis for constructing charges for services;
3. Shared use of equipment and services offered by common carriers;
4. Restrictions on use of services offered, including prohibitions against resale thereof;

What new common carrier tariff offerings or services are or will be required to meet the present and anticipated needs of the computer industry and its customers.

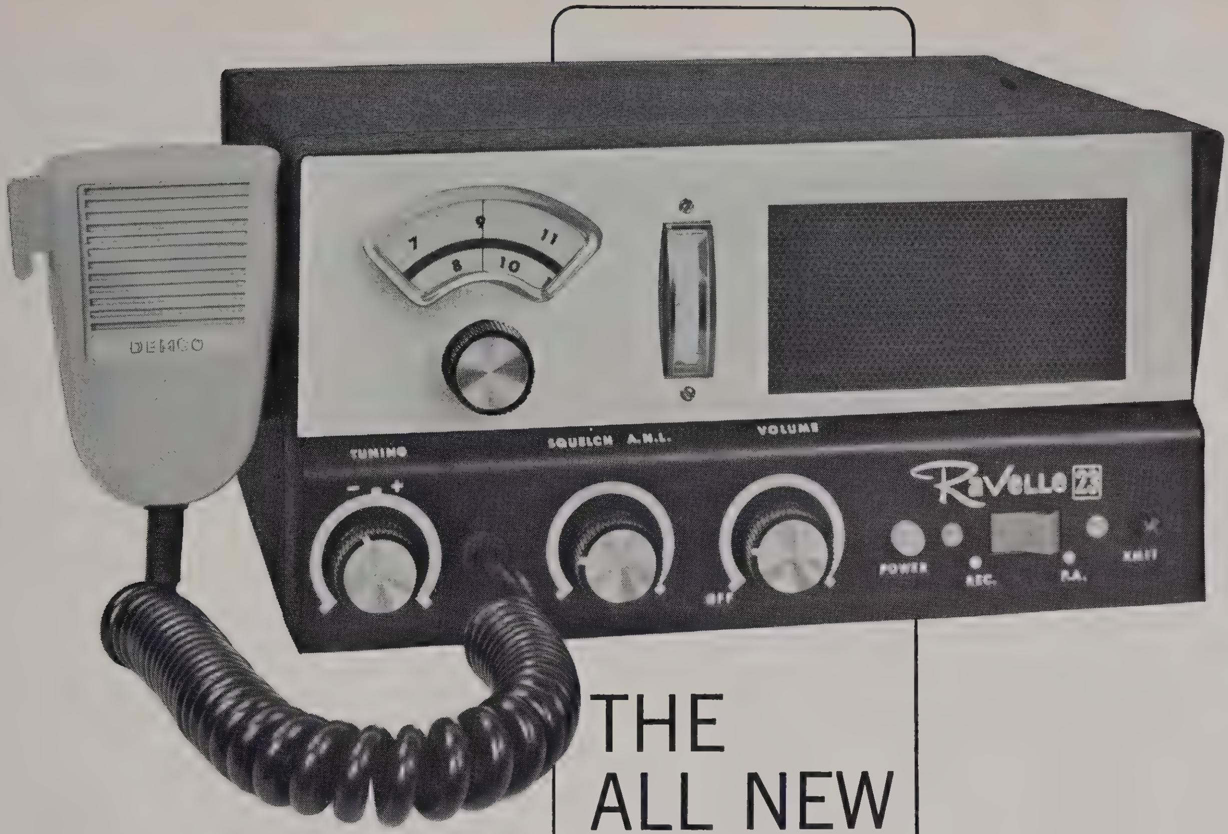
The respects in which present-day transmission facilities of common carriers are inadequate to meet the requirements of computer technology, including those for accuracy and speed.

What measures are required by the computer industry and common carriers to protect the privacy and proprietary nature of data stored in computers and transmitted over communication facilities, including:

1. Descriptions of those measures which are now being taken and are under consideration; and
2. Recommendations as to legislative or other governmental action that should be taken.



Part of the FCC investigation will involve data transmission facilities as illustrated here. Tape equipment shown here is made by Tally whose president is Russell Dubois, former mobile radio sales manager for RCA. ☐



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CALLING CHANNEL

What has been the experience of the Pennsylvania Railroad using inductive carrier wayside-to-train communications systems, and why did they abandon it? Do they have a report on its use? Any information you might engender would be appreciated.

John K. Hilliard
Director,
LTV Research Center

- *The Pennsylvania, Duluth, Missabi and Iron Range, Kansas City Southern and the Burlington railroads were among the first railroads that installed inductive carrier systems before the FCC had allocated radio channels for railroad use. The inductive system has the advantage that long range coverage can be attained as long as the wire to which the base station signal is fed is close to the tracks. The main disadvantage is noise because of the low frequency of operation. Also, longer range than required can result.*

All of the railroads using inductive carrier, as far as we know, abandoned it a long time ago with the exception of the Pennsy. All of the other railroads use VHF/FM space radio whose range can be easily controlled and whose communications quality is superior.

Since there is essentially no market for new inductive carrier train communications equipment, no one manufactures it.

I couldn't help but comment on your article on handsets in the October 1966 *Communications*. We wholly attempt to minimize the use of handsets by our customers. In fact many of the RCC users on interconnected channels prefer the microphone to the handset—unless their main use of the telephone is to impress the sweet young chicks they manage to transport.

For just the reason you say—public is used to handsets—we feel they are bad on congested channels. Microphones psychologically suggest dispatch techniques where handsets get you in the telephone rut of niceties . . .

I hope too many people don't take your article too seriously. Next thing you'll be suggesting that interconnection in business and industrial services is a good thing. Heaven forbid.

Robert J. Hajek
POI-C Communications
Riverside, Ill.

- *We would like to hear how others feel about handsets.*

In a recent issue of *Communications,* the article, "Fast Transistor Check" you mentioned, among others, a "Kierluff Model K & K" transistor checker. We have a company here (and in Los Angeles) spelled "Kierulff." Thinking your spelling might have been in error, I called them. The individual I talked with knew nothing about a "Model K & K." Would you please let me know more about this unit—who sells it, etc?

E. H. Abel
Moto-Radio
San Diego, Calif.

- *The model was right; the spelling was wrong. Marty Baer of Kierulff Electronics, 2585 Commerce Way, Los Angeles, informs us that the "Model K & K" is produced by a subsidiary, Quality Electric Co., also of Los Angeles.*

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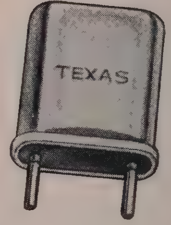

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PUBLIC SAFETY

[illegible]

Election Night 1966

As the computers estimated, on the basis of the flash tallies (first twenty-five votes counted), what the outcome of the November 8, 1966 elections would be, your correspondent turned his attention to the contests where the friends of land mobile radio were running for re-election. Now, admittedly there were many issues in the election campaigns that were much more important than the plight of the land mobile radio users, and it is therefore logical to conclude that the results don't really give any clear cut view of our present position in Congress. However, there are a couple of areas which are worthy of further study.

First, how did we fare in the election? To put it simply, we were indeed fortunate. One of the most active groups presently helping the land mobile radio users is the House Small Business Committee. Four members of this Committee: Conte (Mass.), Corman (Calif.), Dingell (Mich.), and Kluczynski (Ill.) have been particularly energetic in attempting to get the Federal Communications Commission to move forward more rapidly in efforts to find a solution. All four of these gentlemen are returning to Washington for the 90th Congress. We can assume that they will continue their efforts with the same vigor.

Another group which could exert a considerable influence on our behalf, (but which has not to date), is the House Appropriations Committee. For example APCO proposed to the Advisory Committee for the Land Mobile Radio Services on several occasions that funds should be made available for obtaining the help of professional research people. True, the Committee did vote to postpone consideration of the proposal even though the various Public Safety representatives on the Committee supported it. This is quite understandable since a number of the industrial user groups have access to help from research people or organizations; however, Public Safety, which is representative largely of governmental entities at the city and county level is not so fortunate; cities and counties simply do not use taxpayer dollars for research and development.

Suppose that the House Appropriations Committee had become interested in the case of Public Safety and had moved a bill through Congress to provide money for funding a study of the needs of Public Safety in the radio spectrum. Such a study was requested by APCO in a Petition filed with the Commission on December 6, 1962 but the petition was denied. If action had been initiated by Congress, then the studies would have been made. The fact that the APCO position was correct has since been corroborated by the report of the working group chaired by Robert Casselberry. This group is making good use of the research work done by two different organizations.

The truth of the matter is that the House Appropriations Committee hasn't been involved in the land mobile radio problems and therefore the elections did not affect our position with that Committee.

Turning to the Senate, there are two committees and two subcommittees that are important to land mobile radio. First, there is the Senate Commerce Committee Chaired by Senator Magnuson. Commissioner Cox, Chairman of the Advisory Committee and Senator Magnuson know each other well. Another member of this Committee is Senator Pastore, who is Chairman of the Communications subcommittee. Both Senators Magnuson and Pastore are members of the Senate Appropriations Committee and the subcommittee for independent offices. These two gentlemen will continue in the 90th Congress; however, they need our help in convincing their colleagues. With more encouragement from the land mobile radio users, Senator Magnuson's Committee might have exerted more influence on the FCC.

A second area of interest would be to examine the issues that brought about the election results and to determine if there is any connection to the land mobile problem. The network commentators verified that in some contests civil insurrections or disorders played an important part in the decision of the voters. This was certainly true in California where the Watts Riot influenced the election results to a considerable extent. But did the voters have any knowledge of the breakdown of communications? Obviously not; and if they did then their normal reaction would be that it is the problem of the Police Department. Deputy Chief Thomas Reddin has been attempting to bring the truth to the public, as well as to those people who are in a position to help. So have some other people; but the fact still remains that the radio spectrum shortage was not an issue and therefore we gained nothing. On the other hand there are more than seventy new members of Congress who need to hear of our problems.

While considering Congress and its activities, it is most encouraging to report that Senator Jacob K. Javits of New York introduced a bill in the U.S. Senate on August 19, 1966. This bill (S3740), a "Law Enforcement Equipment Bill," was proposed as an amendment to the Law Enforcement Assistance Act of 1965.

Senator Javits, in introducing his bill, commented: "One area where Federal action can be most effective is in equipping local police departments. Accordingly, my bill would expand the Law Enforcement Assistance Act to provide an additional $10 million a year for the acquisition of modern equipment by local law enforcement agencies. The act now provides grants to local law enforcement agencies for training programs and to demonstrate new techniques of law enforcement. While such grants are indeed helpful, they do not reach the problem of equipment shortages and overworked personnel in our police departments, which continue to undermine effective law enforcement.

"As President Johnson has said: 'Swift, fair and effective justice for all is a meaningful deterrent to crime.' I believe that technology is vital to effective law enforcement. Thus, for example, computerized records could free policemen from hours of tedious record research, hours that could and should be spent preventing crime. Transistorized radio transmitters and receivers promote swift communications so vital to enforcement efficiency, but too many departments lack the resources to establish an

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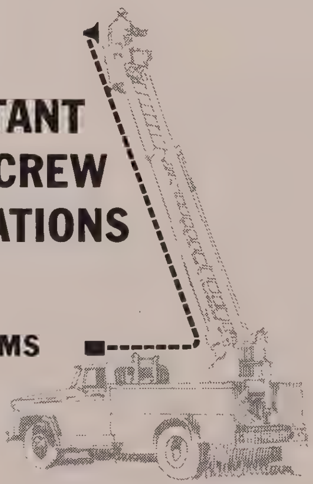

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adequate communication system.

"My bill would allow local police to buy and use the most modern communications equipment to tie every officer on duty to a dispatching center which would electronically record the location of each policeman."

Senator Javits is to be commended for his efforts in behalf of law enforcement and the public safety. There are many agencies that could use more hand-carried radios, better communications command consoles, and emergency intersystem radio; all could use computers or access to computers. One of our most serious problems is the length of time required to obtain information on a suspect; if this can be reduced from days to minutes, the rate of apprehension of criminals will show a drastic increase. Therefore the Senator's bill deserves our support because it represents a real effort to provide funds to purchase this hardware.

Perhaps it would be well to add a note of caution. Most of our crime is committed in our largest cities. These cities are the very ones that are presently suffering from a shortage of radio spectrum. The City of New York in Senator Javits own state is a prime example. It is not a matter of funds to buy equipment; there are no frequencies available for the additional radios needed. (See "New York Channel Scarcity" p16, November Communications). The Federal Communications Commission has been persuaded that the problem is so serious that it has just announced a decision to authorize the use of ten Forestry Conservation frequencies by the Police Department of New York City. Certainly this will help, but it will not provide a complete solution; the entire area has a frequency shortage problem. Thus, in spite of Senator Javits efforts, more equipment will not resolve the problem; we need the equipment, but we need frequencies on which it can be operated too.

A reallocation of the radio spectrum is a necessity if the law enforcement agencies are to have the communications they need to reverse the ever increasing volume of crime in this country. To this end the aid of all members of Congress whom we can enlist will be needed. ☐

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Power Supply Standardization

By
Leo G. Sands

There is a sharp trend toward use of radio communications equipment employing a 12-volt DC power supply for all applications whether for use at fixed locations or as mobile units in cars, trucks, trains and boats. This makes it possible to use the same equipment in any application. It reduces spares requirements and eases the maintenance problem.

At fixed locations, primary power is obtained from the AC line through a rectifier. Where continuity of operation would be required in event of power failure, a storage battery is provided, floated across an automatic battery charger. Normally, power is furnished by the charger. When AC power is not available, the battery becomes the primary power source.

Because of the low standby drain of solid state equipment, the battery can handle the job over extended periods until AC power is again available to replenish the charge in the battery. Even when the equipment employs tubes in the transmitter and a solid state receiver, high battery current is usually required during a minute fraction of the time.

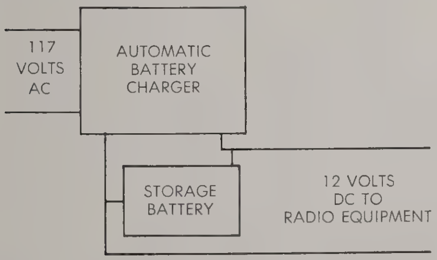


Figure 1. Fail-safe Power Supply For Base, Fixed or Repeater Station.

Thus, a 12-volt mobile unit can be used as a base station, as shown in Fig. 1. The presence of the battery does not add significantly to cost or maintenance. The only routine attention required by the battery is adding water. The battery and charger of course, can be eliminated by using a rectifier.

Some railroads have expressed dissatisfaction in having to use two kinds of train-mounted equipment, a 12-volt set for cabooses and a 72-volt set for locomotives. The problem can be avoided by installing a converter in locomotives for converting 72 volts DC to 12 volts DC, as shown in Fig. 2. Then, 12-volt sets could be used in either application.

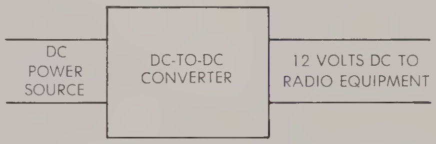


Figure 2. Power Supply System For Locomotives and Ships as Well as Fixed Locations With DC Power Only.

On ships and larger pleasure craft, the electrical system may deliver anywhere from 24 to 230 volts DC. In many cases, a DC-to-AC motor generator or rotary converter is used to provide AC for the operation of radio equipment. Recently, solid state converters have been developed for this purpose with capacity greater than 10 KVA.

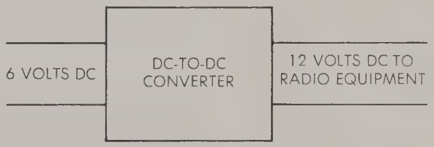


Figure 3. Power Supply System for 6-volt Vehicles.

But, when using solid state equipment, why go from DC to AC and back to DC when only DC is required? Of course, in the solid state DC-to-DC converter, AC is involved internally within the converter, but we don't have to be concerned with it in the external hookup.

The DC voltage conversion problem also arises when installing mobile radio in a vehicle equipped with a 6-volt battery. Here again, a DC-to-DC converter can be used, as shown in Fig. 3.

The problem is getting a suitable DC-to-DC converter. The simplest and most reliable is a dynamotor or a motor generator. But, in this solid state age, rotating machines are not popular. Solid state 6-volt to 12-volt converters are available for use with solid state CRS equipment as are 117-volt AC to 12-volt DC power adaptors.

Reliable, industrial-grade DC-to-DC converters for use on locomotives and ships are being developed and will be available soon. Cost will depend greatly on demand.

So far, we have been concerned with mobile and fixed transceivers and transmitter-receivers. Now, let's consider walkie-talkies. When they are used at fixed locations, the batteries may run down rather rapidly. This can be avoided by using an AC adaptor which several walkie-talkie manufacturers offer. It is also easy to make one as Fig. 4 indicates. Here, a 12.6-volt filament transformer is used in conjunction with a diode rectifier and a ripple filter. When used with a walkie-talkie employing 12 volts of dry battery power, connect the adaptor across the batteries. By leaving the batteries in the circuit, additional ripple filtering and voltage regulation are provided.

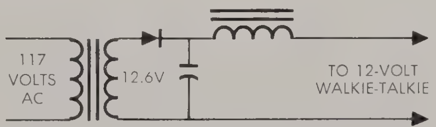


Figure 4. AC Power Supply for Walkie-Talkie Used at Fixed Locations.

The 12-volt input scheme will be used more and more as mobile radio equipment becomes fully solid state. The techniques discussed here will work with hybrid equipment (tubes in transmitter, everything else solid state), but is even better when used with fully solid state equipment. ☐

Ways to Eliminate

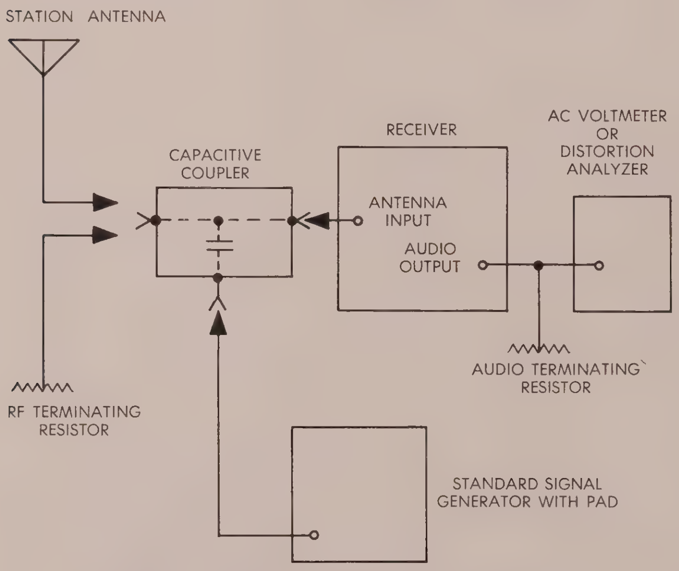
Base Station Intermodulation

By A. K. Guthrie
General Electric Company

It's no great trick these days to design and maintain a radio system in which the base station receiver hears everything it's supposed to hear. Instead, the real challenge is to keep the receiver from hearing what it's not supposed to hear.

If you scare easily, let someone else listen first when you open up a new channel or relocate a station receiver. The shock of hearing garbage on a frequency you thought to be "clear" may be too much for you! If you think that interference constitutes an ever increasing problem, you're right. *Interference comes from lack of separation.* Two kinds of separation are pertinent—frequency separation and geographical separation—we're losing ground in both.

More and more transmitters are being crammed into a non-elastic spectrum. Channel spacing has decreased steadily, partly through technological advances and partly through necessity. The unoccupied channel is becoming extinct as the dodo bird. You have neighbors, many neighbors, and they're moving closer, closer, closer, to your operating frequency.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CAPACITIVE COUPLER
RECEIVER
ANTENNA INPUT
AUDIO OUTPUT
AC VOLTMETER OR DISTORTION ANALYZER
AUDIO TERMINATING RESISTOR
RF TERMINATING RESISTOR
STANDARD SIGNAL GENERATOR WITH PAD

Figure 1. Test Setup for Measuring Receiver Degradation.

Stations are moving closer together geographically, too. Since we're adding transmitters but not adding land, geographical spacing must be on the decline. More significant, though, is the bunching together of stations. As the economic benefits of radio communications are proven and recognized, more and more users are prepared to spend the money required to utilize the best station site available. Base stations serving areas of hundreds or thousands of square miles tend to concentrate in a few hundred or thousand square feet at the one clearly superior site in each area. Their antennas glare at each other; each makes it tough for the others to function. Lack of geographical separation is just as real on the one good hill overlooking Podunk Center as on the roof of the tallest building in a maegopolis. Togetherness brings trouble.

Given sufficient time, talent and money, you can solve or mitigate almost every case of interference affecting an RCC base station receiver, provided you can obtain the cooperation of the owners of equipment which may be causing or contributing to the problem. To convince someone else that he should spend money and possibly live with system degradation just to relieve you of an interference problem requires the patience of Job and salesmanship of the highest order! The selling job is mainly left to you; after all, you're the one who reaps the benefits.

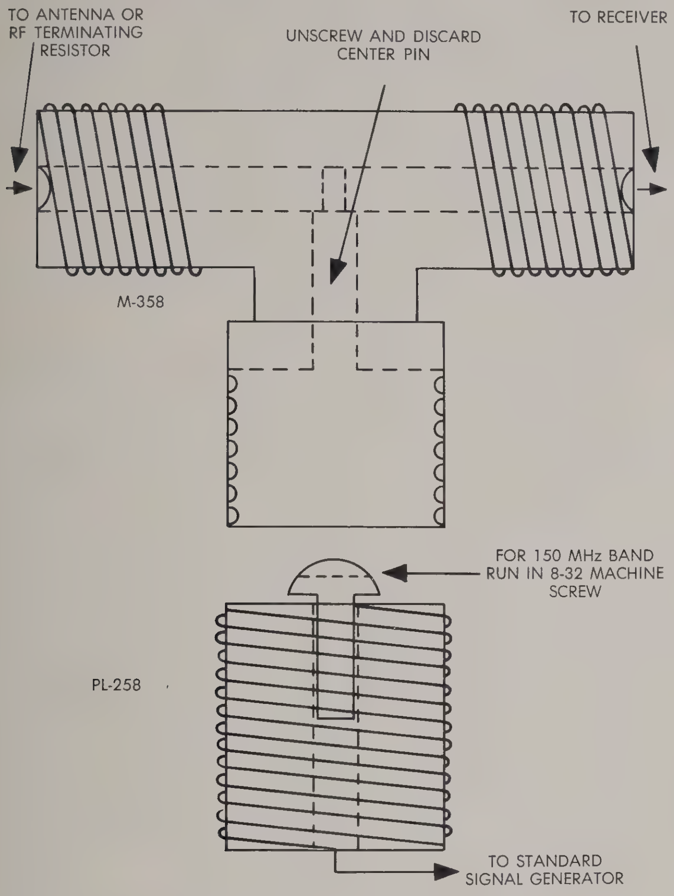
FCC Rules applying to "the other guy" are so far out of step with the times as to be almost useless. An interfering transmitter can be pure as the driven snow, legally, and still completely disrupt your operations. For example, a Business Radio Service licensee is required to attenuate spurious outputs 5 MHz away from his transmitting frequency to −43 dbw. Assuming he operates an 80-watt transmitter with antenna gain of 6db and has a spurious output suppressed to the legal requirement "dead on" your operating frequency, he can open the squelch of your modern base station 12 miles away, and still be legal. It isn't impossible that an interference problem can be resolved by finding and correcting a transmitter which is out of compliance with the Rules—it just seldom happens in practice!

Describe The Problem In Numbers

If the interference condition causes an undesired input to be heard by the receiver, *you must know the level at which it is received so that you can determine how far it must be suppressed.* The handiest RF voltmeter for the purpose is the base station receiver itself. Simply note the indication at an unsaturated metering point in the receiver (AGC, if present, must be disabled) when the interfering signal is being received. Disconnect antenna from the receiver and substitute a calibrated standard signal generator. Adjust generator output to yield the same metering point indication and then read the interfering signal level off the generator's attenuator scale. Unless you're lucky and solve the problem quickly, you'll be making many signal level measurements before you're done. You can make the task a bit easier by plotting a graph of meter indication vs. signal level for a wide range of signal values. For maximum convenience, label your graph with both microvolts and −dbm (both read from the signal generator attenuator) as you go along.

If, instead, the interference condition degrades the performance of your receiver without creating an undesired output, the question "How much?" is just as important but a lot more trouble to answer. A test setup as shown in Fig. 1 is required.

The capacitive coupler may be any fixed or adjustable device which decouples generator sufficiently from receiver input. Arrange or adjust coupling so that 2K to 5K microvolts generator output is required to quiet the receiver when input to coupler is terminated by a 50 Ohm resistor.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UNSCREW AND DISCARD CENTER PIN
TO RECEIVER
M-358
FOR 150 MHz BAND RUN IN 8-32 MACHINE SCREW
PL-258
TO STANDARD SIGNAL GENERATOR

Figure 2. Improvised Capacitive Coupler.

A suitable capacitive coupler may be improvised from two standard UHF-series coaxial connectors as shown in Fig. 2.

Using the test setup shown in Fig. 1, you may measure receiver degradation due to interference as follows:

1. Connect RF terminating resistor to the capacitive coupler input.
2. Adjust standard signal generator to receiver frequency, and measure receiver sensitivity using 12db SINAD (preferred) or 20db Quieting method. If measurement is not in the range 2K to 5K microvolts, adjust capacitive coupler to bring measurement within that range. Note sensitivity from −dbm scale of generator's attenuator.
3. Now, substitute station antenna for the RF terminating resistor. In the presence of the interfering signal, again take sensitivity by the same method selected for step 2. Note this new sensitivity from the −dbm attenuator scale.
4. The difference between readings obtained in steps 2 and 3 is the extent to which receiver performance is degraded by the interfering signal, expressed in db.

Similar comparisons may be taken in the absence of interfering signals to disclose the degree to which the receiver is desensitized by ambient noise. If a number of transmitters are suspected of contributing to loss of receiver performance, measurements should be made as they are keyed individually.

You Must Go To The Source

Regardless of its source, if undesired energy (signal or noise) is on-channel when it reaches the input of your receiver, there is no way to take it out without also taking out the desired signal. You must determine early whether the interference problem has its origin in your receiver or if the receiver is merely responding to on-channel energy.

The receiver is best given a clean bill of health by elimination. There are only two significant mechanisms by which a receiver can respond to an off-channel signal. The least likely is through a spurious response. Intermodulation processes are more likely to be the culprit. Degraded performance on the desired channel due to interference is likely to result from receiver desensitization.

Each of these three common receivers can be easily identified. If encountered, the problem source is at the receiver, and the problem will be solved there —if it's ever solved.

If an interference problem exists and it's not related to one of these identifiable receiver characteristics, it's external to the receiver and no amount of receiver work will ever fix it.

Receiver Spurious Responses

There's nothing very mysterious about spurious responses. Every one can be predicted mathematically —the worst ones can be predicted by quick inspection of the receiver block diagram. Fig. 3 is the block diagram of a typical receiver.

Since low-side injection is used in both mixers, the two image responses (one per mixer) will each be two times the IF frequencies *below* the operating frequency, or:

$$\begin{aligned} F_{\text{image}} = F_o - 2\,(F_{IF}) &= 158.55-2\,(10.7) = 137.15 \text{ MHz} \\ &= 158.55-2\,(.455) = 157.64 \text{ MHz} \end{aligned}$$

If high-side injection is used for a mixer, its image response will be two times the IF *above* the operating frequency.

There are also four "half IF" responses (two per mixer). For our typical receiver, which uses low-side injection for each mixer, these responses are:

$$\begin{aligned} F_{1/2IF} = F_o - \frac{F_{IF}}{2} = &= 158.55 - \frac{10.7}{2} = 153.20 \text{ MHz} \\ &= 158.55 - \frac{.455}{2} = 158.3225 \text{ MHz} \\ = F_o - \frac{3F_{IF}}{2} &= 158.55 - \frac{3(10.7)}{2} = 142.50 \text{ MHz} \\ &= 158.55 - \frac{3(.455)}{2} = 157.8675 \text{ MHz} \end{aligned}$$

If high-side injection is used, the "half IF" spurious responses are *above* the operating frequency.

A series of spurious responses is spaced from the operating frequency by multiples of the frequency of each oscillator.

In our example receiver, multiples of the first oscillator at 49.2833 MHz can possibly yield responses at:

59.9834 MHz 109.2667 MHz
207.8333 MHz 257.1166 MHz

Multiples of the second oscillator at 10.245 MHz can contribute responses at:

138.060 MHz	148.300 MHz
168.795 MHz	179.040 MHz

Spurious receiver responses seldom give trouble since an extremely healthy signal is required to get through a receiver, even if its frequency coincides exactly with the response. For a receiver with 60db spurious rejection, an undesired signal must exceed about 300 microvolts to cause trouble on the worst response—the others require still more signal. For a receiver with 80db spurious rejection, it takes 3K microvolts to exceed threshold on the worst response.

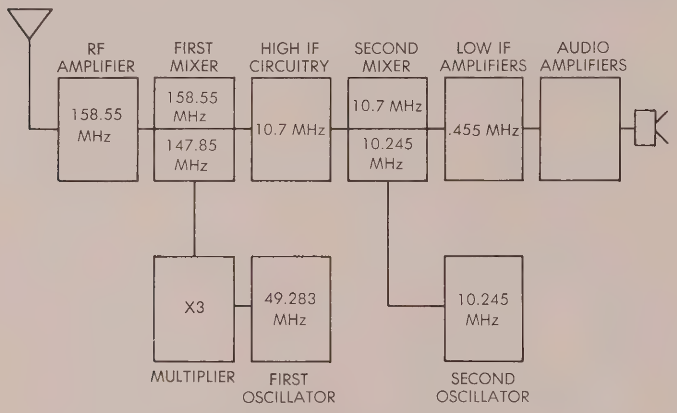


Figure 3. Typical Receiver Block Diagram.

If you suspect trouble from a receiver spurious response, take inventory of the transmitters which could deliver signals of these magnitudes to your receiver and compare their frequencies with the calculated spurious responses of your receiver. To confirm your analysis (or to determine if you've overlooked a troublesome response), set a signal generator to the suspected interfering frequency, feed it into the receiver at the appropriate level, and see what happens.

Once identified, elimination of a particular spurious response is simplicity itself. Merely get a new oscillator crystal which switches injection to the offending mixer. If the receiver uses high-side injection, switch to low-side and vice versa. You'll still have spurious responses, but they will be elsewhere and, hopefully, not troublesome. If your problem involves the second oscillator, your receiver manufacturer can probably supply the required crystal right off his shelf.

It's also possible to suppress the undesired response by a filter added ahead of your receiver. Using your signal generator, determine the level of interfering signal necessary to duplicate the metering point indication you get from the offending transmitter. Then, see how many db you must reduce the output of your signal generator to drop below receiver threshold. That's the number of db by which the filter must attenuate the undesired off-channel signal.

Receiver Intermod Responses

Any receiver has at least one non-linear element, the first mixer, protected from off-channel signals only by the front end selectivity. In the presence of extremely strong signals, early RF amplifier stages (which are protected by even less selectivity) may become non-linear.

If two or more off-channel signals appear at this non-linearity, frequency multiplication and mixing results, yielding products which may lie within the pass band of your receiver, or often exactly on your operating frequency. This process is called intermodulation (IM).

Books can and have been written covering the ways in which signals can combine to become obnoxious. Here are a few examples to give you the idea:

(a) Strong signals from transmitters on 155.925 MHz and 155.21 MHz get into your receiver. Second harmonic energy from the 155.21 MHz signal beats against the other, thus:

2(155.21) − 151.925 = 158.495 MHz

If you happen to be running your receiver on Channel 1 (158.49 MHz) you're treated to police calls, with modulation doubled, only 5 KHz from your operating frequency.

(b) Both your Channel 1 (152.03 MHz) and Channel 2 (152.15 MHz) transmitters deliver strong signals to your Channel 1 (158.49 MHz) receiver. A mobile on Channel 3 (158.61 MHz) drives close to your equipment site. You hear him on both *channels.* Here's what happens:

152.03 + 158.61 − 152.15 = 158.49 MHz

Diagnosis of the "IM disease" comes easier than the cure! First, using your graph of meter indication vs. signal level, determine the level of the IM product. Now, borrow the 6 db pad from the ever-present signal generator, and install it in the line between antenna and receiver, and again not the level. If the level drops by only the 6 db pad loss, too bad—you didn't find the trouble. The undesired product is reaching your receiver on-channel. Nothing you can do to the receiver (short of turning it off) will help!

If, however,your 6 db pad drops the product by 18 db or more, you've struck pay dirt—*the problem is receiver-produced intermodulation.*

The solution lies in suppressing the undesired signals before they reach the first non-linearity in the receiver. Various alternatives are available. You may install a resonant cavity (or other bandpass filter) which passes the desired signal and attenuates all others. You may install a stop filter or trap which attenuated one or more of the trespassing frequencies specifically.

Gain reduction, ahead of the first receiver non-linearity, can often drop a troublesome receiver-produced product below threshold. For each 1 db loss of sensitivity you elect to take, you gain 3 to 5 db of intermodulation product reduction. Quite often, this trade-off is completely painless since the ambient noise level may not permit you to use the full sensitivity of a modern receiver anyway.

Receiver Desensitization And Transmitter Noise

Since both of these phenomena create the same effect, we'll examine them together. Both reduce the effective sensitivity of your receiver, but neither provides any audible announcement of its presence. The existence of one, the other, or both can be confirmed usingthe test setup of Fig. 2. Arrange to key each suspected transmitter and measure the resulting degradation of receiver effective sensitivity.

Receiver desensitization occurs when an extremely strong off-channel signal self-biases an amplifier toward cutoff, thus reducing its gain. The indication at an unsaturated receiver metering point drops. Transmitter noise, on the other hand, involves energy actually radiated from the transmitter. This band of noise extends, at rapidly decreasing level, a few MHz each side of the operating frequency. If of sufficient level at the receiving frequency, this noise appears to the receiver as on-frequency energy which must be overcome by desired signals. The presence of transmitter noise is indicated by a rise in indication at the receiver metering point.

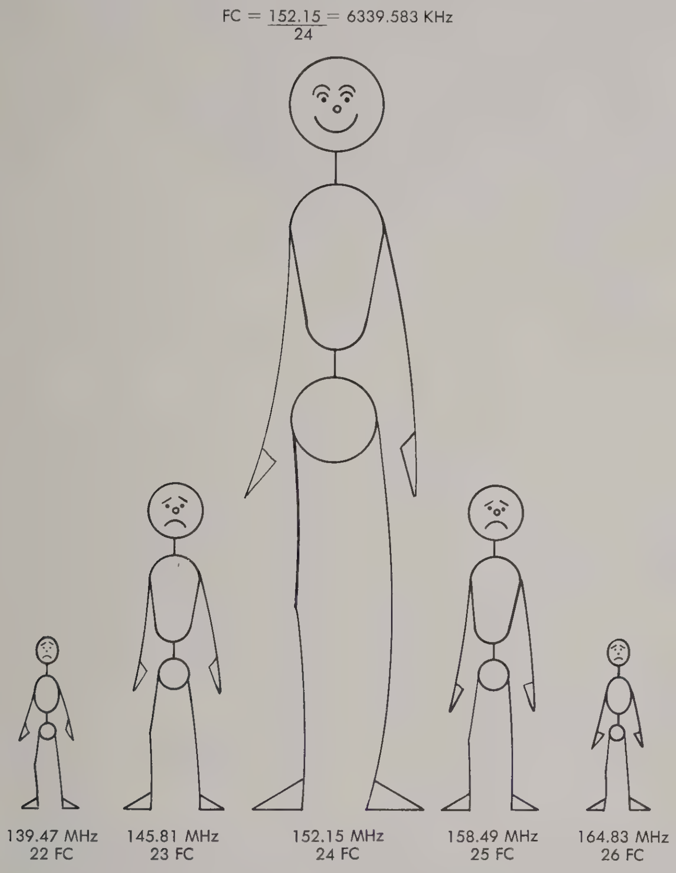


Figure 4. Spurious Outputs of Typical Transmitter at 152.15 MHz.

Obviously, both transmitter noise and receiver desensitization problems may be mitigated by increasing physical separation between transmitters and receiving antennas. Filtering, installed in the antenna system, can be effective, too. Transmitter noise may be attenuated by a band pass filter for the transmitting frequency or a band rejection filter at the receiving frequency, either of which must be installed at the transmitter. Desensitization is treated by a band pass filter at the receiving frequency or a band rejection filter at the transmitting frequency,either of which is installed at the receiver.

Transmitter Spurious Emissions

Transmitters used in the Land Mobile services start out with a crystal oscillator at relatively low frequency which is multipled several times to reach the operating frequency. Total multiplication of 24 is most often used in the high-band. Multipliers of 12, 18 and 36 are sometimes encountered.

In addition to the desired frequency, low-level energy at other multiples of the crystal frequency appears at the transmitter output. While each of the spurious outputs is down many decibels from the transmitter output power level, if one falls on or near your operating frequency it can cause trouble.

Fig. 4 shows the spurious emission pattern of a typical base station transmitter operating on Channel 3 (152.15 MHz). This mathematical accident gives you a glorious opportunity to interfere with your own receiver on Channel 1 (158.49 MHz).

Transmitter spurious emissions which interfere with RCC base station receivers are likely to originate from transmitters operating around 152.1 MHz. To determine the frequency of the most likely offending transmitter, multiply your base station receiver's frequency by 24/25. RCC mobile receivers are vulnerable to transmitters operating around 158.5 MHz. To "zeroin," multiply your receiving frequency by 25/24.

Transmitter spurious emissions must be suppressed at the source—the offending transmitter. Filtering at the transmitter output is the universally accepted method. *Don't change the transmitter frequency multiplication unless you're prepared to tangle with the FCC Type Acceptance routine!*

Transmitter Intermodulation

There are many similarities between transmitter intermodulation and receiver intermodulation—the effect is the same, the mathematics are the same, the processes are the same—only the location of the nonlinear element is different. This time, the frequency multiplying and mixing takes place in the final amplifier stage of one of the offending transmitters.

As shown in Fig. 5, an external signal is coupled to a second transmitter where it combines with second harmonic energy to yield an undesired intermodulation product. This new signal is then radiated and appears to your receiver as in-channel energy. You can do nothing at your receiver to suppress it.

Transmitter Intermodulation must be suppressed at the source—the transmitter where the mixing occurs. Given sufficient frequency spacing, conventional resonant cavity filters; once as the external signal is attenuated on its way to the final amplifier, and again as the IM product is attenuated on its way out of the final amplifier. When close frequncy spacing precludes the use of cavity filters, ferrite isolators may be applied effectively.

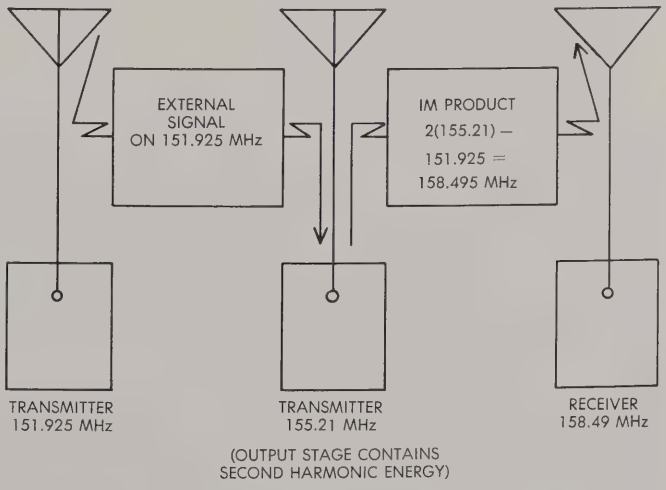


Figure 5. Transmitter Intermodulation

Happy Hunting!

With persistence, systematic analysis, application of both science and witchcraft and a lot of luck, you too can enjoy "interference free" reception. ☐

Some Sleuthing Techniques To Aid In The Difficult Search For

Intermittents

One of the most time consuming jobs is tracing down the cause of intermittent operation of communications equipment. Now it works, now it doesn't, and then it works when you touch (or in desperation kick) the equipment.

There are many causes of intermittent operation including: cold solder joints, erratic tubes, dirty relay and switch contacts, defective capacitors, poor socket-to-pin contact, defective coils, and changes in resistor values.

Some elusive defects can be made to reveal themselves by increasing the AC (or DC) input voltage. If you don't have a Variac (variable autotransformer), you can use a 6-volt filament transformer to boost line voltage as shown in Figure 1. The 6.3-volt winding boosts line voltage by 6.3 volts when switch S is in the "boost" position. If it drops the line voltage, reverse the 6.3 volt winding leads.

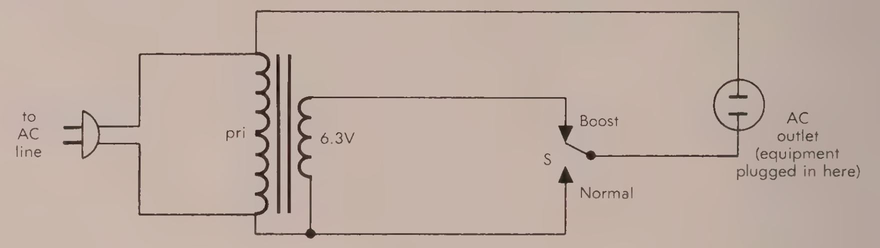


Figure 1

Heat may also reveal intermittent defects. Place an infra red heat lamp over the equipment being serviced. Or, put a cardboard box over the equipment to cut off ventilation and accelerate self-heating.

A quick way to find poor connections and tubes with loose elements in an AM receiver is to feed a very strong unmodulated RF signal into the antenna terminals. Then prod the tubes and parts with the eraser end of a pencil.

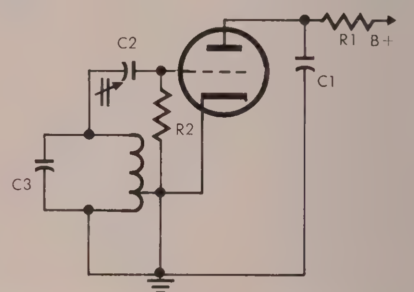
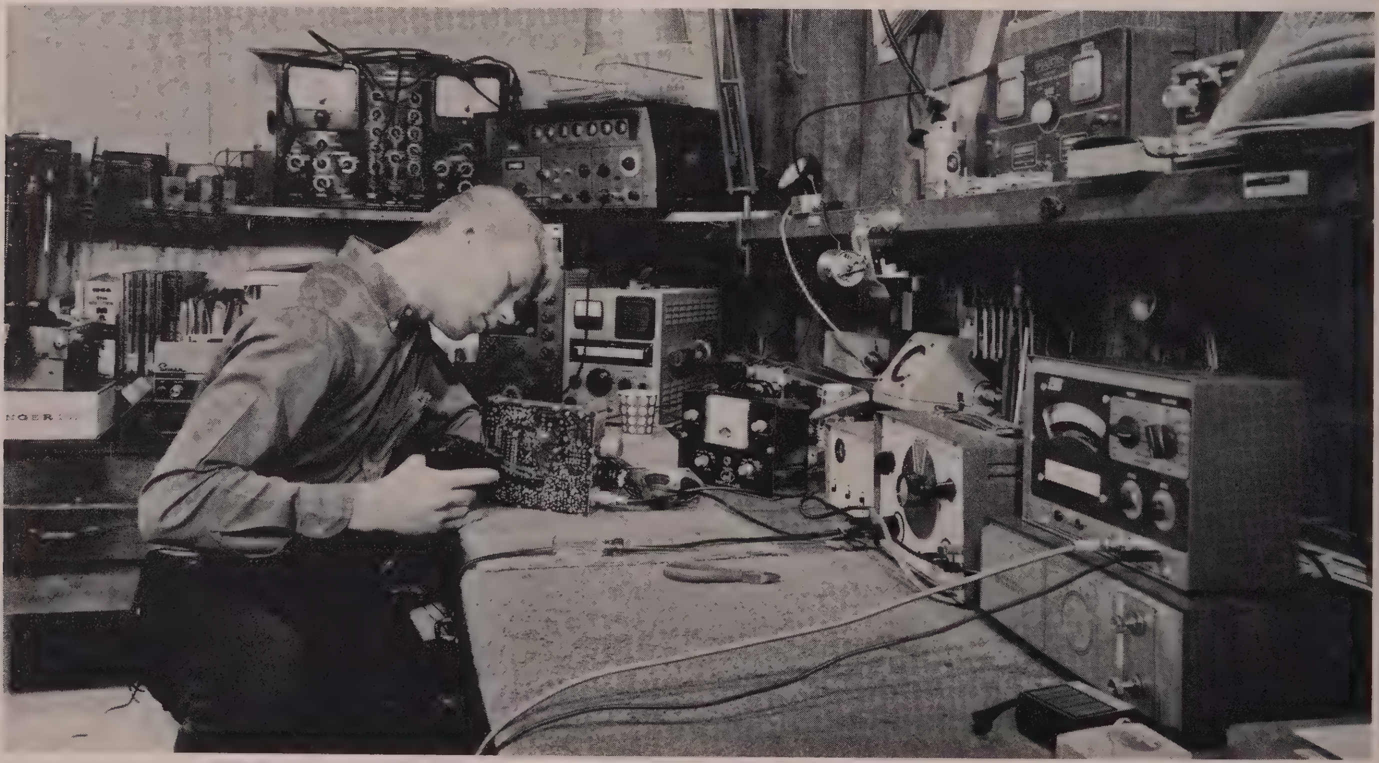
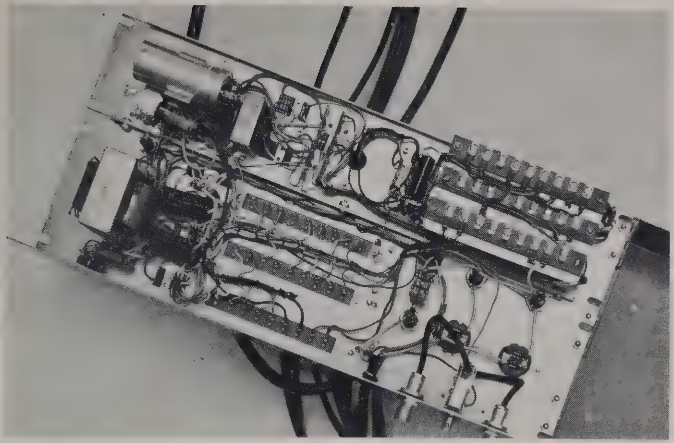


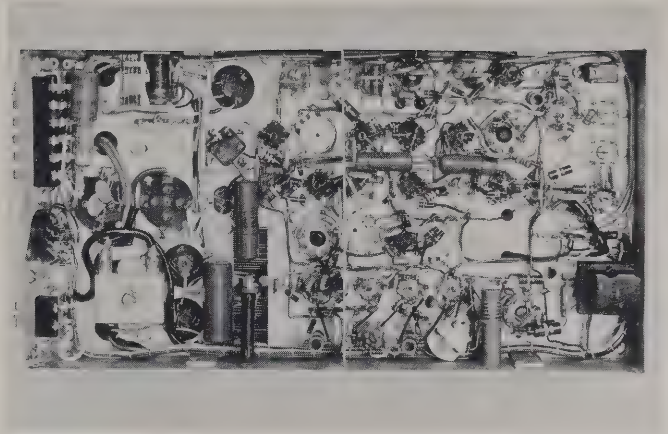
Figure 2



A poor solder connection on a printed circuit board can cause intermittent operation.



One possible cause of intermittent operation could be loose screw terminals such as those shown at the top right.



Several hundred possible sources of intermittent operation exist under a mobile unit chassis. Watch out for loose connections or shorts, capacitors on the verge of shorting, etc.

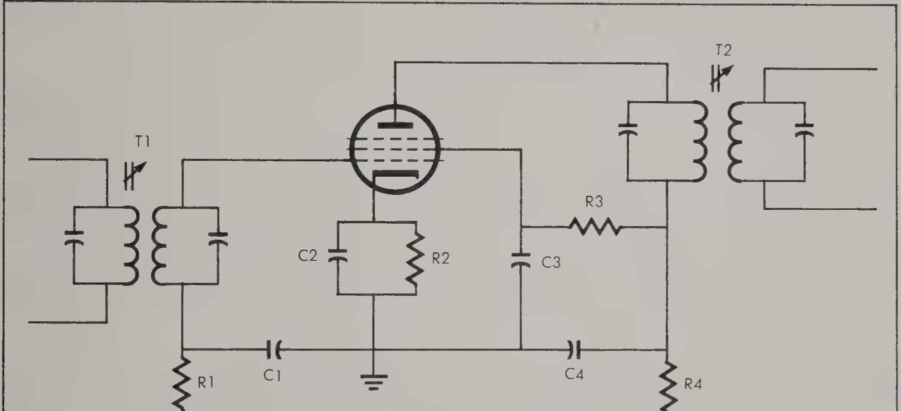


Figure 3

Often a capacitor will open momentarily and cause intermittent operation. In an oscillator circuit, for example, if capacitor C1 in Figure 2 should open, the oscillator will stop functioning since the plate of the tube will no longer be at RF ground potential. If C2 opens, oscillation will stop because the feedback path is open and gird leak bias will cease. The oscillator may continue to function, but at the wrong frequency, if C3 opens.

In an IF or RF amplifier or mixer stage, opening of any of several capacitors can cause intermittent operation. Opening of C2 or C3 can cause a drop in gain since degeneration will be introduced. If C1 opens, gain will also be reduced since R1 will be introduced into the signal path. The same is true of C4 with respect to R4.

Opening of a capacitor may or may not have an effect on DC operating voltages and may be difficult to detect. Shorting of a capacitor, on the other hand, usually causes a drop or absence of DC voltage in the affected circuit.

Changes in the values of resistors are usually slow and might not cause intermittent operation. However, if R1 or R2 in Figure 2 change in value, oscillator operation may become erratic and the oscillator may pop in and out suddenly.

Relay and switch contacts are notorious causers of intermittent operation. Contacts which handle significant amounts of current tend to clean themselves unless sparking causes burns. Contacts which switch "dry" circuits are more apt to cause intermittent operation. Figure 4 shows an example of a dry circuit. Here the contacts transfer the input of an audio amplifier from a receiver detector to a microphone or output of a preamplifier. The back contacts of an antenna switching relay can be a source of trouble since these contacts handle microscopic current and signal levels in the microvolt region.

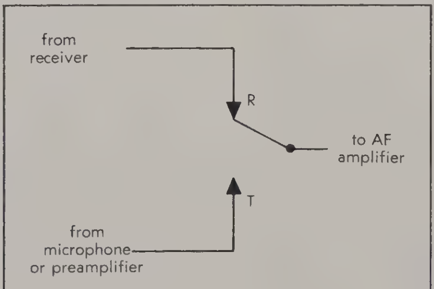
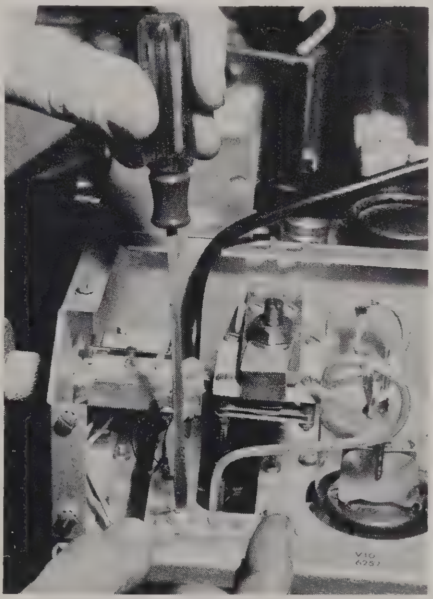


Figure 4



A loose antenna coil positioning screw could cause flutter and erratic operation under mobile conditions.

Sometimes such troubles can be cured by cleaning the contacts with a contact burnishing tool (never a file or sandpaper). Often, it is better to replace the relay or switch. The contacts will stay clean longer if you place a moth ball near them (anchored in some way). The evaporating gas lubricates the contacts.

When in doubt about the cause of an intermittent condition, it is sometimes cheaper to replace all suspected capacitors. They usually cost much less than manpower. □

Monolithic Crystal Filters

Selectivity is becoming an increasingly important problem in communications, whether transmission is via radio or over wires or coaxial cable. Mechanical and crystal lattice selectivity filters are widely used in mobile radio and carrier telephone systems. L-C and R-C filters are commonly used in tone signaling systems.

The recent development of a very simple monolithic crystal filter by the Bell Telephone Laboratories, and the development of the extremely selective Twintron electromechanical filter by H B Engineering Corporation, offer great promise as lower cost, more effective filters.

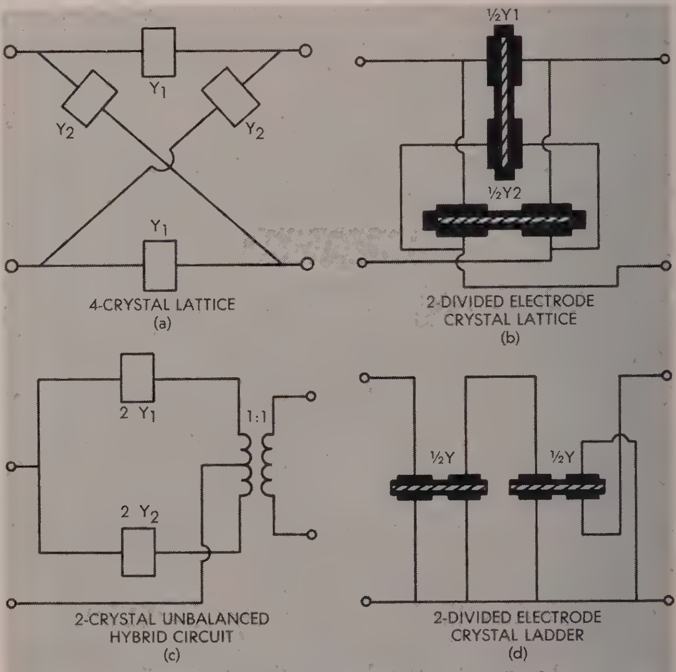
This two-part article is a condensation of a paper given by *B. A. Sykes* and *W. D. Beaver* of Bell Telephone Laboratories at the 20th Annual Frequency Control Symposium sponsored by the Electronic Components Laboratory, U. S. Army Electronics Command, Fort Monmouth, New Jersey.

While this article is not exclusively related to mobile radio applications of filters, much of the basic information should be of interest to all communicators.

Various types of crystal filter networks are employed as single frequency and voice frequency channel filters. Particular emphasis is placed on the dividend electrode type crystal unit and its lattice equivalent. Previous attempts to use multi-resonant high frequency crystal units with divided platings in conventional filter configuration have been limited by the range of resonance frequency placement and resultant image impedances of the filters. Proper choice of resonator electrode disposition gives more latitude in the placement of the critical resonant frequencies. The unique placement of critical frequencies in the lattice equivalents permits an improved characteristic resistance over the transmission band. No additional components are required to provide essentially flat transmission bands.

The performance characteristics of monolithic crystal filters can be very simply stated: the fractional bandwidth in Hz/MHz is a direct multiple of the termination resistance. A single crystal plate may be used to form a monolithic filter that may be terminated in 100-ohm circuits with a resulting bandwidth of .005% of the mean frequency. This may be used for a single frequency selector in the range from 6 to 25 MHz over normal temperature ranges. Bandwidths as high as .07% may easily be realized which can allow the use of single side band channel filters at carrier frequencies as low as 6 MHz. Other conventional crystal filters may be realized by the addition of inductors and/or capacitors within the limits that the equivalent lattice of crystal unit imposes. Monolithic filters of this type may be considered as a mechanical filter formed by elastically coupled resonators.

Before considering the use of "monolithic" crystal filters for high frequency band selection, let us briefly review how crystal units with divided and undivided electrodes have been used previously. In Fig. 1, the original four-crystal lattice, as conceived by Mason, is shown at (a), in which equal crystal units were used in the series arms and in the lattice arms, respectively. He showed that the four crystal units can be replaced by two with divided electrodes and connected to form a lattice structure, as indicated in (b). This divided plate structure resulted in the first practical application of crystal units to frequency selection, and formed the basis of the original crystal channel filters used in carrier telephone transmission systems. As the needs developed for higher frequency channel filters utilizing smaller size quartz plates, the structure shown at (c) was developed. This permitted the use of undivided electrodes, but still retained all



4-CRYSTAL LATTICE
(a)

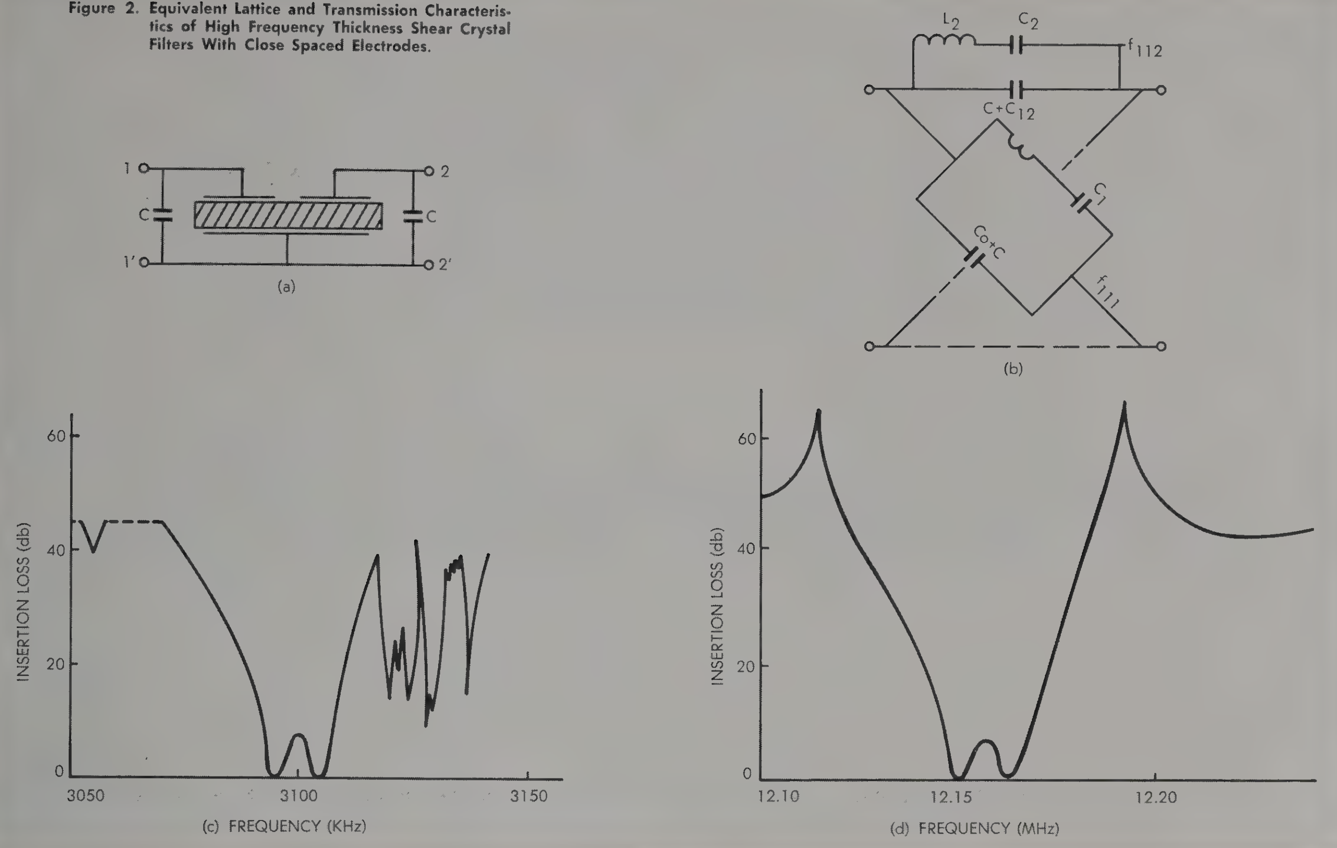
2-DIVIDED ELECTRODE CRYSTAL LATTICE
(b)

2-CRYSTAL UNBALANCED HYBRID CIRCUIT
(c)

2-DIVIDED ELECTRODE CRYSTAL LADDER
(d)

Figure 1. Crystal Unit Networks Having Essentially the Same Lattice Equivalent.

Figure 2. Equivalent Lattice and Transmission Characteristics of High Frequency Thickness Shear Crystal Filters With Close Spaced Electrodes.



the advantages of the original crystal lattice, namely that of *a band-pass structure having complete flexibility of loss peak placement with approximately equal impedance crystal units.* It was found that the divided electrode crystal unit could be connected as shown at (d), an unbalanced structure, and still retain the transmission properties of the lattice structure. *The important advantage is the freedom to place the loss peaks in the vicinity of the transmission band.* The use of crystal units with undivided electrodes in a ladder structure, as is well known, limits the placement of the loss peaks to regions close to the pass band. All four of the circuits shown in Fig. 1 have approximately equivalent transmission characteristics, and the type of circuit used would depend on the frequency range and crystal unit construction. A single section of the structure shown in Fig. 1(d) has been used in a number of applications for carrier and pilot selection at both low and high frequencies.

One such application of a single divided plate crystal unit was developed in the early 1930's for the selection of a pilot frequency at 3096 KHz. The usual circuit schematic and equivalent lattice are shown at (a) and (b). While the insertion loss characteristic (c) definitely shows two pass bands as well as poor loss discrimination on the upper side of the band, due to unwanted responses,it did have sufficient loss characteristics below the pilot frequency to satisfy the requirement. It has long been known that these two pass bands result from the antisymmetric and symmetric modes of the high frequency thickness shear. When this type of design is used employing present high frequency crystal unit principles, improved loss characteristics may be obtained as shown in (d). It

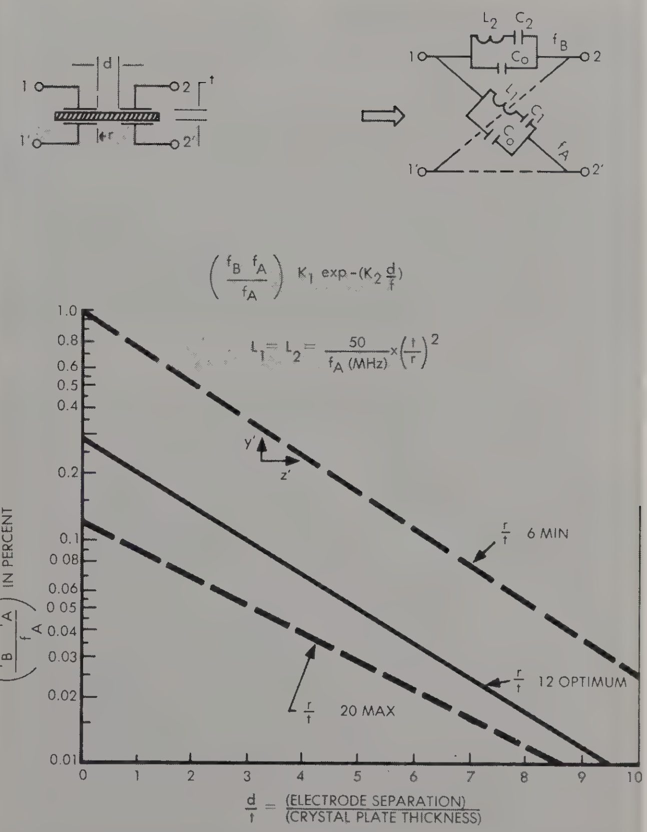


Figure 3. Percent Frequency Difference Between Equivalent Lattice Crystal Units as a Function of Resonator Separation.

can be seen that the same two transmission bands result from antisymmetric and symmetric modes produced by the divided electrode. A number of attempts have been made to fully utilize the two frequencies resulting from these two modes. For example, adding series inductance to make these two bands overlap usually results in a good transmission band, but too wide for most applications. Only small variations in these resonant frequencies are possible because they are determined by the dimensions of the crystal plate.

During the course of some experiments to determine the dependence of the separation in frequency between these two modes on the individual resonator design, *it was found that the symmetric and antisymmetric modes of a quartz crystal unit with divided electrodes could be considered as two individual coupled resonators, and that in fact, the coupling between them would be a direct function of each resonator design as well as the separation between them.*

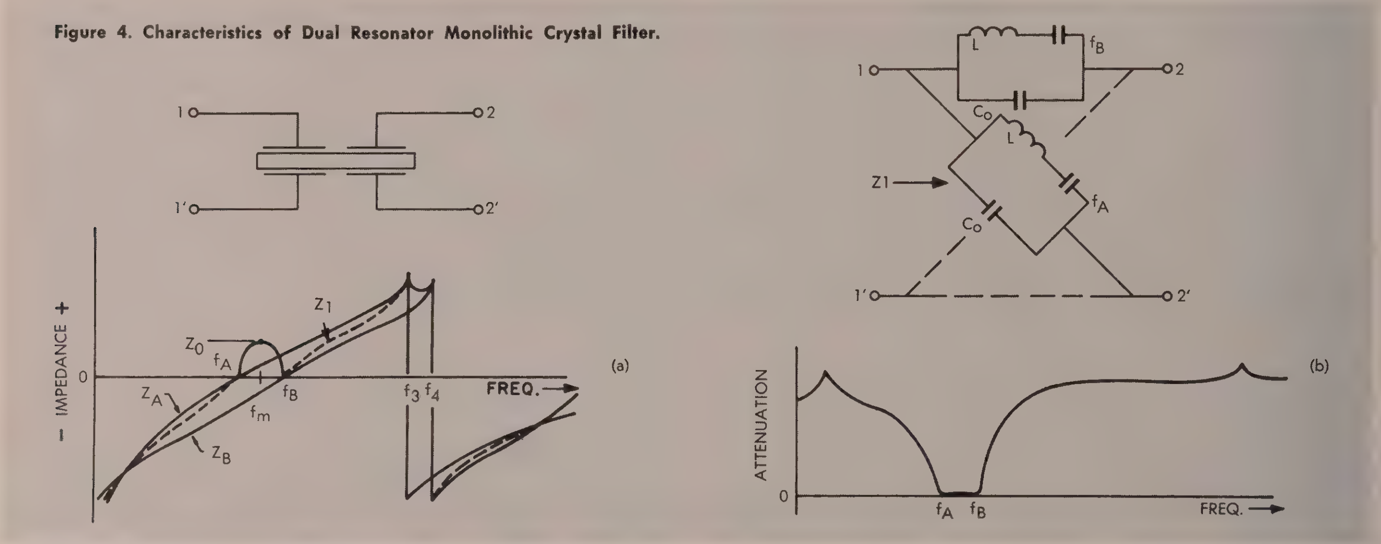


Figure 4. Characteristics of Dual Resonator Monolithic Crystal Filter.

A summary of this investigation is shown in Fig. 3, in which the solid line shows the fractional frequency difference between the resonant frequencies of the symmetric and the antisymmetric modes, as a function of separation of an optimally designed pair of resonators. In accordance with trapped energy principles, larger or smaller area electrodes may be used, provided appropriate changes in the electrode thickness are made. The two dotted lines for $r/t=6$ and $r/t=20$ are practical limits which may be used.

It may be well to point out at this time that further discussion of symmetric and antisymmetric modes is not as important to consider as that of simply coupled resonators. For example, let us recast the statement. Fig. 3 shows the characteristics that may be obtained with two coupled resonators formed on a common quartz plate and how coupling between them varies with separation. The equivalent circuit of this four-terminal network is a lattice network composed of two equivalent crystal units whose resonant frequencies are determined by the frequency of the individual resonators off-set by the coupling between them. The difference frequency between the equivalent crystal units shown in the lattice network can be approximated by a logarithmic function, as shown in Fig. 3.

The inductance of the equivalent crystal is also obtained by previously established methods involving the area of each individual electrode, as well as the piezoelectric coupling constant. Its approximate value, following trapped energy optimum design, is shown in Fig. 3. This now gives us the degree of flaxibility that is required for high frequency crystal filter design, namely complete freedom in the placement of the resonant frequencies. For example, a conventional narrow band filter would be one in which the second resonance were made coincident with the antiresonance of the first mode and a standard series of filters could be developed. The addition of film type capacitors might be necessary.

If we add no additional components to this structure, the reactance frequency characteristic of the two arms Z_A and Z_B in the lattice equivalent will be as shown in Fig. 4(a). Upon applying the usual equations to determine its transmission properties, we find that two pass bands occur, $(f_B\text{-}f_A)$ and $(f_4\text{-}f_3)$.

Between the two resonant frequencies, a mid series constant-K type impedance is observed, and between the antiresonant frequencies a mid-shunt constant-K type impedance is observed. If each band is somewhat less than the total frequency difference between resonance and antiresonance, a high ratio of midband resistances is found. If we terminate this network to obtain the transmission properties for the lower transmission band, the reflection loss at the higher transmission band is so high that the band is hardly noticed, as shown in Fig. 4(b). The termination resistance for the low transmission band is proportional to the inductance of the resonator and the bandwidth desired. Using the value for inductance given for dual resonators on Fig. 3, an extremely simple design criteria may be established.

The bandwidth in Hz of a monolithic crystal filter composed of two resonators equals one half the product of termination impedance in ohms and the midband frequency in MHz. For example, a 100-ohm filter at 10 MHz will have a bandwidth of 500 cycles. A 1,000-ohm filter will have a bandwidth of 5,000 cycles, or more generally, 100-ohm filters at any frequency will have a bandwidth of .005%. Different impedances and bandwidths would call for an appropriate design of electrodes and separations.

(To Be Continued)

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20 Years of Microwave

By Leo Sands

Two decades ago, the consulting firm of Sloan, Cook & Lowe was making a study of the feasibility of the use of microwave by the Southern Railway. Now, the Southern operates one of the world's largest private microwave systems. It took a long time for the railroad to act after the initial study, but when it did act, it did so in grand style.

Microwave started more than 20 years ago. It was about 36 years ago that ITT made an installation in Europe. But, it was not until 1947 that microwave got going in the United States. And by 1950, microwave had developed into a big business.

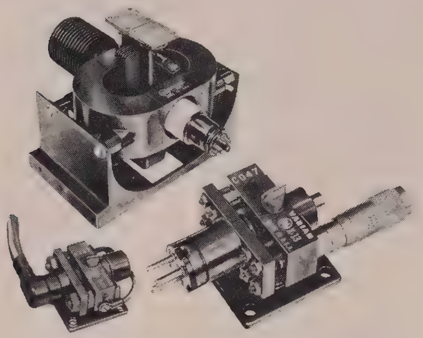
The pipe lines were the first to install private microwave systems on a big scale. The Atlantic Refining Company installed an ITT-Federal PTM system in the Philadelphia area. The Transcontinental Pipe Line Corporation installed a GE system stretching from Texas to New Jersey. Numerous other pipe lines installed microwave systems using Philco, RCA and Motorola equipment.

The Long Island Railroad installed an experimental Sperry system, but the Rock Island was the first U. S. railroad to install a microwave system on a permanent basis. The Santa Fe was second by a few months. Philco sold both systems. No other railroad microwave systems were installed for five years until the Southern put in a pilot system in Florida.

The electric power utilities also joined the microwave parade. The Bonneville Power Administration initially installed an ITT system in the Pacific Northwest.

The use of microwave is being extended to other than public utilities. Users now include police organizations, schools, manufacturers, and even retailers. Licensing has been opened up to all commercial enterprises. However, those eligible only on the Business Radio Service must operate at frequencies above 10 GHz except when microwave is used for remote control of base stations in which case operation in the 960-MHz band is permitted.

The earliest commercially available microwave equipment operated in the 2-GHz band and employed crystal controlled transmitters. In about 1949, equipment became available for the 6-GHz band which employed non-crystal controlled Klystron transmitters.



Klystrons which ushered in the microwave age may soon become obsolete as solid state devices improve.

Most long-haul systems operate in the 6-GHz band, but the 2-GHz band is making a sharp comeback.

During the past few years, Collins, Lynch, GE, Jerrold, RCA, Motorola and Lenkurt have emerged as leading makers of 6-GHz band microwave systems for long-haul applications. Philco, after becoming the largest maker, bowed out of the field except as a military supplier. Cardion, Farinon and ITT (Kebby) have become the leading makers of 2-GHz equipment. Emphasis on 960-MHz equipment is being made by Cardion (formerly Budelman).

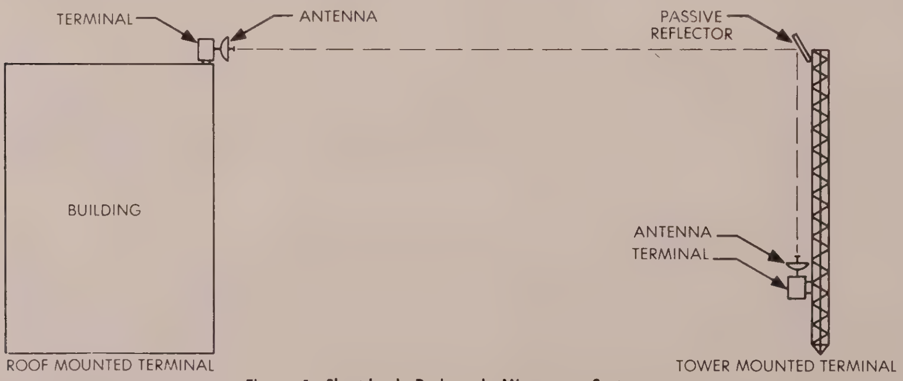


Figure 1. Short-haul, Packaged, Microwave System.

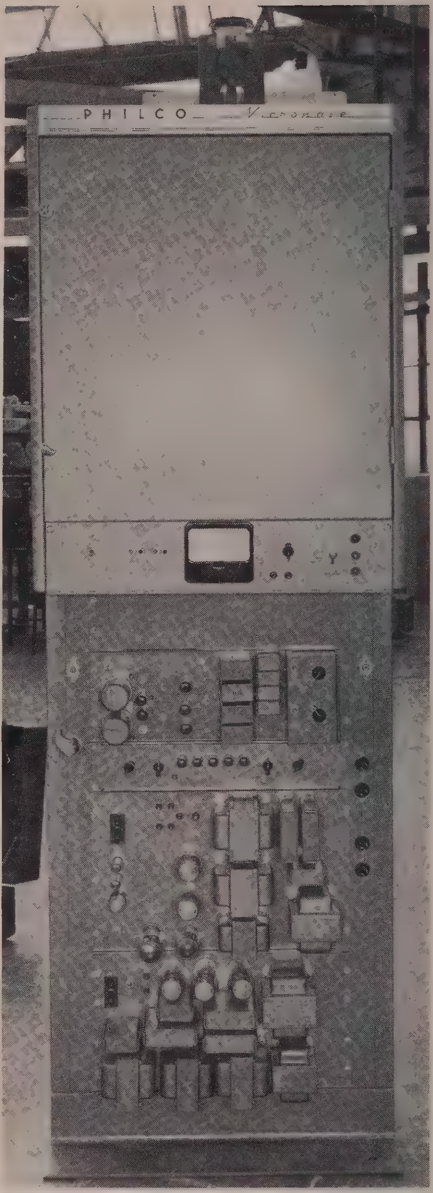
The past few years have seen a giant swing to solid state equipment. The Klystron is still being used in some 6-GHz and 12-GHz band equipment because of its relatively high power output capability (one watt) at those frequencies. But, the rest of the circuitry is solid state. Nearly all of the 2-GHz band equipment is now fully solid state.

Solid state harmonic generator which replaces klystrons.

When tubes are employed, power consumption is significant and it is necessary to provide high voltage power supplies. Fully solid state equipment, on the other hand, can be operated directly from a 24- or 48-volt battery floated across a battery charger. It is becoming feasible to eliminate power lines at isolated repeater stations and obtain power from a thermoelectric generator.

Sales of private microwave systems received a sharp setback a few years ago when the Bell System introduced Telpak service. It offered multi-channel circuits at such low cost as to make microwave non-competitive. The equivalent of 12 telephone channels cost only $15 per mile per month compared to $36 to $50 per mile per month if leased on a per-circuit basis.

The FCC has now ordered the Bell System to revise its Telpak rates so that the service won't be subsidized by other users of telephone service. It appears that Telpak A (12-channel) and Telpak B (24-channel) will be eliminated. This will give impetus to the market for low density microwave systems.



First mass-produced 6 GHz band microwave repeater/terminal, the Philco CLR-6.

A demand is expected to develop for a low-cost, short-haul microwave system package which could be marketed through distributors and dealers. Brown Boveri,

DEALERS: IT'S FREE!
Mr. Dealer, Let us send you one free sample of our plastic holder which will frame & display 20 CB Cards in separate compartments. It's an attention getter & sales stimulator, as well as revenue producer. Fill one with choice cards & watch the crowds gather. Retails 3 holders for $1.00.
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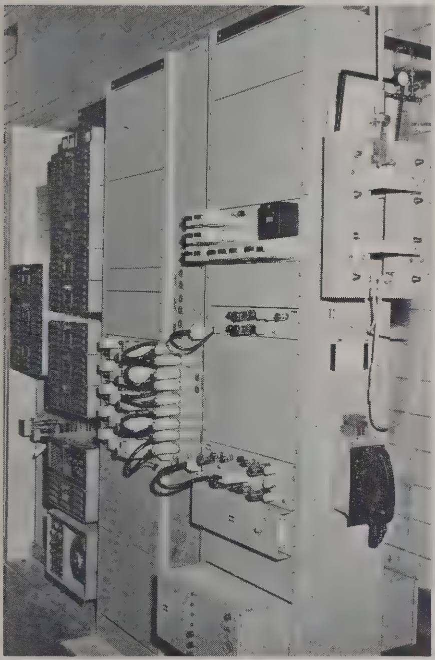
a Swiss firm, had developed such a package but was unable to offer it at a sufficiently low price. Both Olympic and Philco had considered developing such a package a few years ago, but the market had not developed sufficiently at that time.



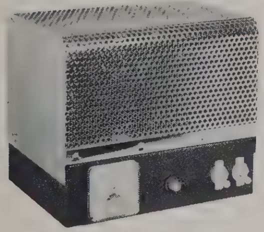
Early General Electric 2 GHz microwave terminal.

There is a growing need for a low-cost microwave system package for use by business, industry, schools, law enforcement agencies and others for short-haul transmission of data and CCTV as well as for remote control of base stations.

Such a system would consist of two compact microwave terminals which could be installed outdoors on a roof top with its antenna directly attached, or at the base of a tower with its antenna pointed upward at a passive reflector. It could also be installed indoors using waveguide or coaxial cable to feed its antenna. If priced at less than $10,000 for a complete two-terminal package, preferably closer to $5,000, it should find an eager market.

Modern compact microwave terminal.

The long-haul, high-density, microwave market will continue to flourish and remain highly competitive. But the industry, except for Cardion and Farinon, seems to have overlooked the short-haul, medium-density market which has the largest number of potential buyers. ☐



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$159.95 complete for base unit, $194.50 for mobile. (Prices slightly higher in Far West.)

Have the increased Range and Power by operating the Model 300A RF Amplifier.
(Illegal for use in Class D Citizens Band.)
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SINCLAIR'S YAGI ANTENNAS

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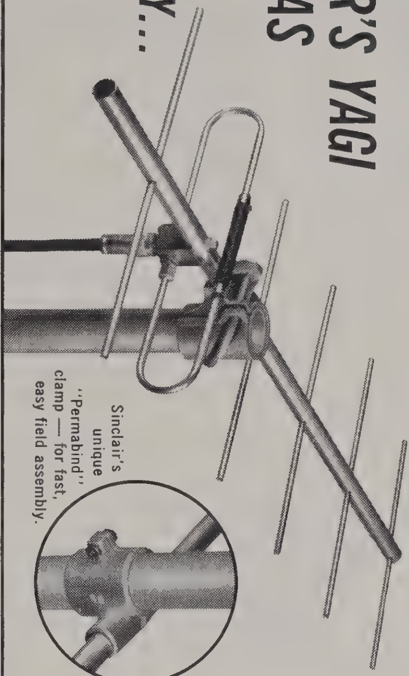

Sinclair's unique "Permabind" clamp — for fast, easy field assembly.

Sure, most UHF-VHF yagi antennas function effectively — when the weather's good! It's when the wind starts to howl and the weather turns from bad to worse that the unmatched rugged reliability of a Sinclair yagi really counts. **Every standard** Sinclair yagi is designed to withstand 110 mph winds with a 1/2" radial ice coating. An integral part of this rugged construction is Sinclair's unique "Permabind" clamp that makes for fast, permanent field assembly.

Standard Sinclair yagis are available in a wide frequency range from 30Mc. to 470Mc. . . . gains from 6.5db to 17.0db . . . power ratings up to one KW. Send coupon today for complete **FREE** literature and prices.

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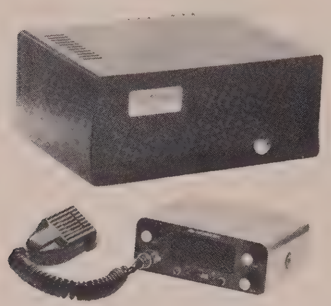
PRODUCT SHOWCASE

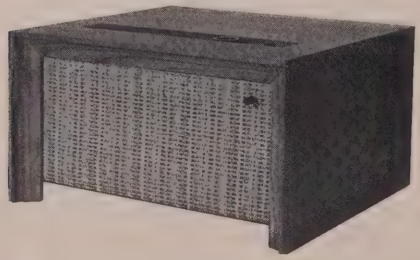
GONSET INTRODUCES NEW DU MONT RADIO

Latest addition to the DuMont Mobile Communications' 960 series is the Comtron 960AR, a two-way mobile radio designed to make radio communication a direct line from base to mobile. The new unit is a rear mount version, and retains all the desirable features of the 960 front mount design. Tests recently conducted by Gonset engineers indicate that the 960AR will really take it in "off the road" service. Solid state circuitry keeps standby current drain at a low level. With the new 960AR there is no need to worry that loading material into the trunk of your vehicle will damage the unit, as all external controls are now located on the control head. For details contact DuMont Mobile Communications, a division of Gonset, Inc., 1515 Manchester Ave., Anaheim, Calif. 92803, or circle RSC #1.



MICRO COMMUNICATIONS REMOTE CONTROL UNIT

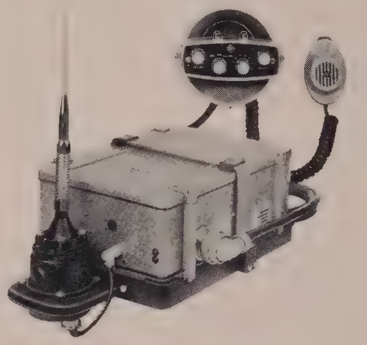
A base station remote control unit which combines distinctive beauty with functional efficiency is now offered by Micro Communications Company. The RSCC-1 Remote Station Controller has a handsome oiled walnut cabinet styled by Schetina. There is no ungainly external mike to clutter up a desk. The front and back are identically finished to present an all around attractive appearance.



The fully transistorized circuitry includes a highly efficient two way compression amplifier utilizing a field effect transistor. The control functions are compatible with all FM stations from the major manufacturers. A variety of commonly used options are available including tone squelch control, and others. For more information write to Micro Communications Company, 2450 West 2nd Avenue, Denver, Colorado 80223, or circle RSC #2.

ARC INTRODUCES 10 WATT HEAVY DUTY INDUSTRIAL RADIO

Aircraft Radio Corporation, a subsidiary of Cessna Aircraft Company, has introduced its 10 watt FM motorcycle and heavy duty industrial mobile radio. According to the company this specially designed version of the ARC Cambridge unit provides performance under most adverse conditions.



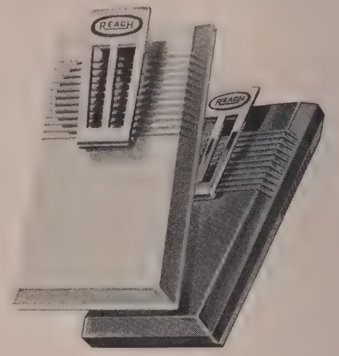
Although engineered primarily for motorcycles the unit is equally adaptable for use on fork lift trucks and a variety of other yard vehicles which are required to operate under all types of weather conditions. The unit features a completely weatherproofed heavy gauge aluminum case

The functional control unit/loudspeaker assembly can be mounted remotely, near the driver and connected by a waterproof cable and connectors. The all-transistor receiver minimizes battery drain and may be "on" for long periods of time without discharging the battery. The use of quick-heat transmitter tubes eliminates the normal warm-up waiting period. The unit operates from a 6/12 volt battery supply, is available for single or multi-channel operation from 25-174 mcs. For details contact Aircraft Radio Corp., Boonton, New Jersey 07005, or circle RSC #3.

VIP-70 POCKET PAGER INTRODUCED BY REACH

The attractive, new Reach pocket pager (Model VIP-70) provides instant voice communication with key personnel in hospitals, manufacturing plants, etc. Reach pagers are pocket receivers having both selective calling and voice instructions, and the manufacturer claims, are the only pocket receivers available with completely hands free operation—each pager turns itself on and off automatically whenever a message is directed to it.

The Reach pocket pager is light weight and fits the smallest pocket. It has completely solid state tone and receiving circuits. There are no reeds in the VIP-70, and the pager operates on 2 size "N" cells (mercury or alkaline).

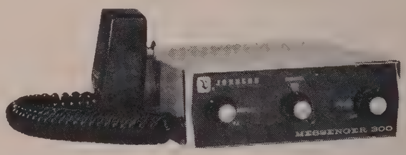


The pager contains built in decoding circuitry which enables the base station or switchboard operator to selectively call individual personnel. Two models are available for operation from either one-tone or two-tone codes. The separate codes which activate the individual pager are produced by a Reach console encoder. These console encoders are available for up to 61 different one-tone codes or up to 3,540 two-tone codes.

No. FCC licensing is required since a closed loop system confines the signal to the vicinity of the building where the pagers are used. Simple installation of an all solid state induction transmitter, together with console encoder and microphone complete the system. For details write Reach Electronics, Lexington, Nebraska, or circle RSC #4.

JOHNSON TRANSCEIVER FEATURES CRYSTAL FILTER

Another new transceiver, the 12-channel, solid state Messenger 300, has just been announced by the E. F. Johnson Company. A major feature of the Messenger 300 is the use of a precision crystal filter in the receiver.

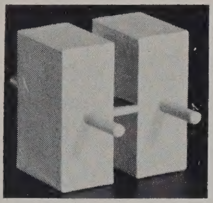


Other features of the Messenger 300 include a multi-stage, noise-limiting circuit, speech compression in the transmitter for more audio power without distortion, a plug for accommodating the Johnson tone alert selective calling system and a built-in PA amplifier.

The Messenger 300 comes equipped for 12-volt DC operation and is furnished with mobile mounting bracket, push-to-talk microphone and crystals for one channel. Johnson also offers two accessory power supplies enabling the Messenger 300 to be operated as a base station or a portable unit, as well. For detailed information, write E. F. Johnson Company, Waseca, Minnesota 56093, or circle RSC #5.

SELECTIVE CALLING RESONATOR

A new electromechanical resonator for mobile radio selective calling and tone squelch applications can be produced with Q of up to 8000. Known as the Twintron, it can be used to generate, select or reject frequencies from a fraction of one cycle per second to 20 KHz. The Twintron is very compact and impervious to position, gravity, acceleration or shock. It is much more stable than a tuning fork or vibrating reed and in quantities cost is as low as $5.00 each.



Because of its extremely high selectivity, it is possible to transmit and select several hundred tones within the voice range. For full particulars, write to the manufacturer, HB Engineering Corporation, 1101 Ripley Street, Silver Spring, Maryland 20910, or circle RSC #6.

JOHNSON INTRODUCES LOW COST RADIO

The E. F. Johnson Company of Waseca, Minnesota is now marketing an inexpensive 100 milliwatt hand-held transceiver which will be priced at $29.95 each retail. This transceiver features a crystal controlled superheterodyne receiver with excellent sensitivity. Audio output is more than adequate to permit operation in noisy areas.

Other features include a built-in battery meter for easy checking on battery strength and a rugged high-styled case, complete with leather carrying strap. For details, contact E. F. Johnson Company, Waseca, Minnesota, or circle RSC #7.

50-MHz ELECTRONIC COUNTER

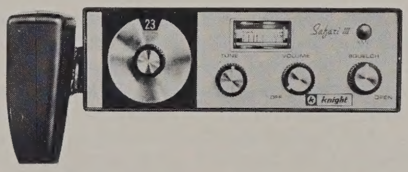
A new electronic counter introduced by Hewlett-Packard has the wide frequency range and front panel accessory plug-in capability of more expensive counters but because certain refinements are omitted, its cost is considerably lower. The basic counter has a maximum counting rate of 50 MHz and it can measure frequencies accurately and with 1-Hz resolution to as high as 12.4 GHz with available HP plug-in heterodyne frequency converters. Although it's an economy model, the new counter has a full complement of gate times.

The new counter (HP Model 5246L) accepts all plug-ins designed for the familiar HP Model 5245L 50-MHz counter. Besides measurements to 12.4 GHz using HP converter plug-ins, the new economy model can measure frequencies directly up to 350 MHz with a prescaler plug-in, operate with a sensitivity of 1 millivolt with a pre-amp plug-in (basic counter sensitivity is 100 millivolts), normalize readings with a preset counter plug-in, or measure time intervals from 1 microsecond to 10^6 seconds and make digital voltage measurements to 1000 volts with two other plug-ins. For details contact Hewlett-Packard, 1501 Page Mill Rd., Palo Alto, Calif. 94304, or circle RSC #8.

KNIGHT KIT TRANSISTOR 5-WATT TRANSCEIVER

The new Knight-Kit Safari III 5-watt 23-channel CB Transceiver, the size of an average dictionary, has full solid-state design. This 1967 model is produced by Allied Radio Corp., Chicago. All silicon transistors are used in the circuit.

An outstanding feature of the Safari III is its great flexibility for base, portable or mobile use. 12 volt DC operation is standard for auto, boat, truck, farm tractor, or mobile home use. The unit mounts into a separate AC power supply, factory assembled, to convert into a base station.



Has transmit indicator light; full 5 watts input power; additional channel crystals are simply plugged into the circuit; double pi output circuit with SO-239 connector matches 50-ohm antenna. Price is $84.50. Complete details are contained in the 1957 catalog available free from Allied Radio Corp., 100 N. Western Ave., Chicago, Illinois 60680 or circle RSC #9.

NEW MIKE FROM MASTER MOBILE MOUNTS

Master Mobile Mounts has introduced the master constant level microphone, Model MCL-4. This mike features a complete audio system in a palm-sized solid state unit. This transistorized microphone represents an "active" approach to noise rejection and intelligibility in voice communications that does not depend on mechanical or environmental conditions. The transistorized circuitry maintains a constant output level with no audible distortion, whether the user speaks softly or shouts, the manufacturer claims.

The MCL-4 features a high-impact cycolac plastic case and neoprene jacketed coiled cord. 1-year replacement warranty on the complete microphone and 5-year replacement warranty on the encapsulated module. For further information write to Master Mobile Mounts, 4125 W. Jefferson Blvd., Los Angeles, California 90016, or circle RSC #10.

1-WATT WALKIE-TALKIE

Lafayette Radio Electronics has introduced several new walkie-talkies for the fall season including the HA-711, a 12-transistor, 1-watt CB handheld portable priced at only $47.95. It is operable on three channels within the band. A special model is also available for operation on the 25.575 MHz government channel or the 26.62 MHz C.A.P. channel. For details write Lafayette Radio Electronics Corp., 111 Jerico Turnpike, Syosset, L.I., N.Y., or circle RSC #11.

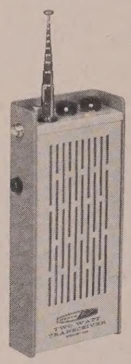
GAM INTRODUCES VHF MARINE ANTENNA

GAM has introduced a new marine antenna for the VHF marine band. The Outrigger, Jr., Model OJR, is 51 inches long overall and is designed to be fed through 50-ohm coax. The half-wave, end-fed radiating element is encased in straw colored fiberglass. It is fed through a high efficiency, broadband matching transformer which is grounded to reduce noise pickup. It is designed to handle up to 200 watts and is equipped with a PL-259connector. VSWR over the156-162 MHz range is 1.5:1 or less. Gain is rated

at 6 db over a coaxial antenna, 3.7 db over an isotropic radiator and 1.5 db over a dipole antenna. No ground plane or hull ground is required. Inquiries should be addressed to Andy Nuttle, GAM Electronics, Inc., 191 Varney St., Manchester, New Hampshire 03102, or circle RSC #12.

HEATH FACTORY ASSEMBLED 2-WATT WALKIE-TALKIE

A new completely assembled and tested 2-watt walkie-talkie was recently announced by the Heath Company. The unit, model GRS-65A, has an operating range of up to 6 miles when used with similar units; up to 10 miles when operated with a 5-watt CRS base station. A rechargeable nickel cadmium battery is included for 8 hours use per charge with a total battery life of up to 5000 hours.



Other features include crystal-controlled transmit and receive; superhet receiver with RF stage; adjustable squelch control and automatic noise limiter; 36″ telscopic whip antenna; external antenna connectors; and a rust-proof heavy-gauge aluminum case styled in 2-tone green. The GRS-65A is priced at $99.95. For details write the Heath Company, Benton Harbor, Michigan 49022, or circle RSC #13.

FREE CATALOG

A new communications equipment and parts catalog is available from Allen Electronics, 41-42 Main Street, Flushing, New York 11355, or circle RSC #14.

NEW "+2" BOOKLETT

Turner Microphone Company, Cedar Rapids, Iowa, has recently made available a booklet called "Connecting the +2 to Your CB Set." The booklet describes the proper connections between the Turner +2 microphone and more than 100 different CB set models, and offers helpful hints for getting the best performance out of particular models when using the +2.

The booklet is recommended both for +2 buyers who do their own servicing, and for dealers who sell and install the +2 units. It discusses 30 different brands of CB and amateur radio sets, and is available from most CB dealers and distributors, or direct from The Turner Company, 909 17th Street N.E., Cedar Rapids, Iowa 52402, or circle RSC #15.

AMPEREX ANNOUNCES "ECONOMOBILE" CIRCUIT KITS

Amperex Electronic Corp. has announced the first in a series of "Economobile" circuit kits—component packages specially designed for manufacturers of mobile two-way radio equipment. The new series was introduced this month at the 1966 Vehicular Communications Conference held in Montreal.

In order to meet the critical requirement of high quality at lower cost, Amperex has matched economy-engineered circuitry with the required components to save enginering time and reduce component costs. The "Economobile" circuit kits are made up of selected packages of tubes, transistors, resistors, capacitors and sockets that provide a variety of power outputs in the popular mobile communications frequency ranges. Each kit is accompanied by a detailed application report which includes a circuit illustration, its layout, an analysis and typical data.

The Amperex "Economobile" Circuit Kit can be made available with or without the sockets and other passive components. Presently available are models ECK-1, ECK-2 and ECK-3. Details and illustrations of circuitry, together with technical data on the transistor types A2126, A2127 and tubes 6360 and 8637, are contained in applications report P-105, a copy of which may be obtained by writing to Amperex Electronic Corporation, Tube Division, Hicksville, Long Island, New York 11802, or circle RSC #16.

POCKET DICTATER

Karl Heintz, Inc. announces the streamlined, all new FI-CORD 300 portable dictating machine with complete Office Transcribing System. Unbelievably compact and lightweight—just 25 ounces—the machine is balanced to fit into the palm. A special friction finish provides hundreds of "suction cups," offering a non-slip grip, even in the most humid weather. 3 springback pushbuttons provide easy, rapid 1-2-3 fingertip operation. No diagrams necessary, it only takes a fraction of a second to switch from record to rewind to listen.

For higher playback volume a lightweight (3½ ounces), very compact amplifier-speaker can be attached to the FI-CORD. The insulated snap-in battery tube takes standard batteries (pen-lite size), available anywhere. The new FI-CORD is available in 2 models: FI-CORD 300—Standard model 1209.95. FI-CORD 303—Compatible with single-track units such as Stenorette $209.95. For complete information write to: Karl Heitz, Inc., 979 Third Avenue, New York, N.Y. 10022, or circle RSC #17.

1967 HEATHKIT CATALOG AVAILABLE

A new 1967 edition of the Healthkit catalog, illustrating over 250 easy-to-build electronic kits is now available for the asking from the Heath Company.

This 108-page kit-builder's treasure, with 36 pages in beautiful color, boasts a kit for every interest, every budget. Kit builders will find complete lines of stereo/hi-fi components, amateur radio equipment, marine electronics, test and lab instruments, citizen's band radio, photographic aids, educational kits, plus many home and hobby items including color TV, electronic organs, portable and table model AM, FM, shortwave radios, intercoms, and garage door opener. For details, mail a post card or note with your name and address to the Heath Company, Benton Harbor, Michigan 49022, or circle RSC #18.

CLASSIFIED SECTION

Rate for classifieds is 25 cents per word for advertising obviously of a non-commercial nature. Add $1.00 for Box Number and reply service. Advance payment is required; minimum order is $4.00. Classified rate to commercial advertisers is $30.00 per column inch (2¼″ col.). Deadline for all classifieds is 1st of preceding month.

HAVE TWO WESTERN ELECTRIC 106A Selectors. Standard Bell issue for Land Mobile and Marine use. Originally $400.00 each. Selling for $50.00 each. Marvin Ve Ann, 3655 Ridgewood, #103, Montreal, Canada.

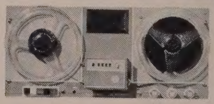
DEALERS, FOR FREE SAMPLE and details on a CB sales gimmick which advertises you but yields a profit itself, write Tepabco, Box 198M, Gallatin, Tennessee 37066.

SERVICE SHOPS interested in performing warranty service for communications equipment manufacturer. Send experience and facility report to Dept. VI-S, Communications, Box 63992, Oklahoma City, Okla. 73106.

WRITER WANTED to research and write technical books and magazine articles. Send samples and resume to Technical News Bureau, 250 Park Avenue, New York, N.Y. 10017.

SALES ENGINEER WANTED to sell two-way mobile radio. Salary, expenses. Send resume to Dept. VI-K, Communications, Box 63992, Oklahoma City, Okla. 73106.

FM SCHEMATIC DIGEST — A collection of 92 pages of 11½ x 17 schematic diagrams and other information specifically related to **MOTOROLA COMMUNICATIONS** equipment, bound in loose leaf form. Included are schematics covering test sets, control heads, remote control equipment, squelch relays, single-tone oscillators, decoders and 6-12 volt conversion and many more—$3.95 postpaid —write Dept. S., Communications, Box 63992, Oklahoma City, Okla. 73106.



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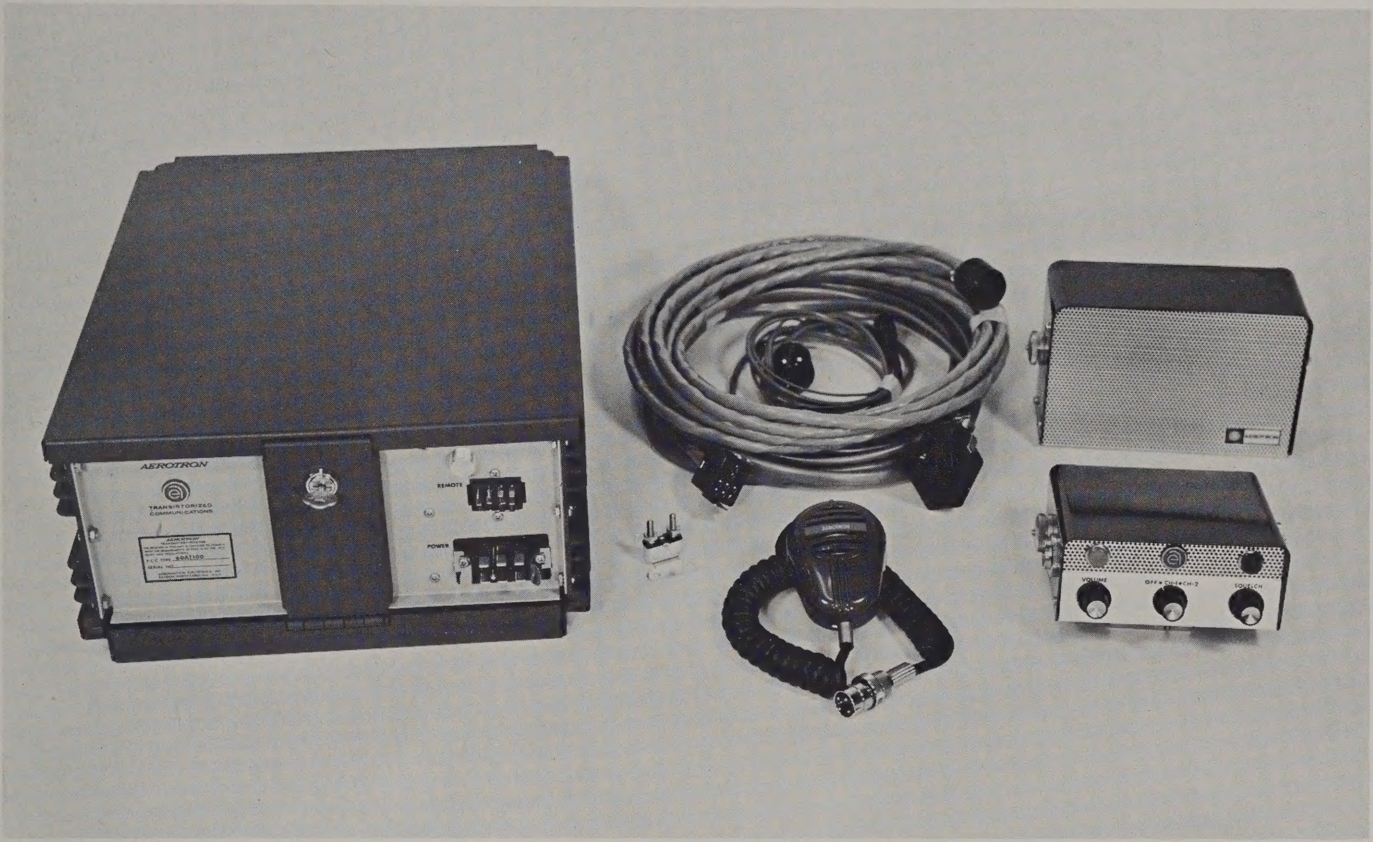

ZOWIE!

Here it is! Aerotron's brand new 100 watt, transistorized VHF-FM (148-174 mc) two way mobile radio. A truly rugged, reliable high-power unit specially designed to meet the most stringent government and industrial mobile radio specifications. The 60AT100 gives you greater range from car to car—from car to base station . . . no dead spots . . . full saturation coverage of your entire area. Its big features include true low-current drain (only 70 ma in standby, no battery saver-switch required), high frequency crystal filter selectivity (pioneered by Aerotron), cavity receiver front-end (for ultimate interference rejection), and complete instant interchangeability between negative and positive ground 12-volt ignition systems. High power, coupled with transistorized circuitry and rugged construction makes the 60AT100 ideal for police, fire, public utilities and other organizations whose requirements call for the utmost in power output and reliability. About the only thing we're short on is the price, $695 FOB Raleigh, complete with microphone, whip antenna, power and control cable, control head, speaker, circuit breaker, all mounting hardware and crystals for single channel operation in the 140-174 mc range. The unit may be equipped for dual channel operation at slight additional cost. Send today for your copy of the 60AT100 brochure with complete specifications. Just ask for "Spec Sheet, 60AT100."

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Uniform appearance front and back.
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For use in all FM radio systems.

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